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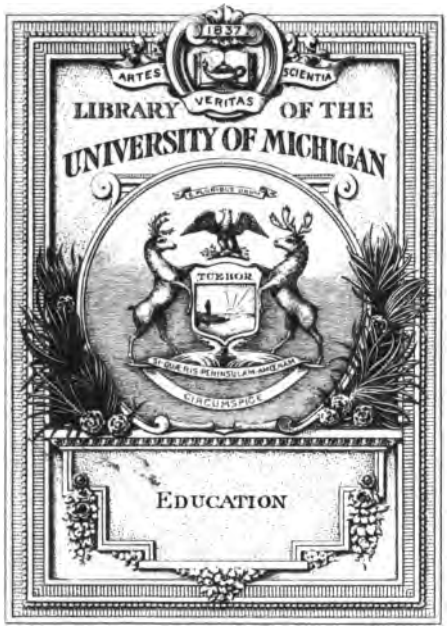
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Department of Public Instruction
LANSING

SCHOOL BUILDINGS, EQUIPMENT, AND GROUNDS

FOR CITY, GRADED, AND RURAL AGRICULTURAL SCHOOL DISTRICTS

Bulletin No. 52

Published by
The Superintendent of Public Instruction
1922

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1922

STATE OF MICHIGAN.
Department of Public Instruction.
LANSING

SCHOOL BUILDINGS, EQUIPMENT, AND GROUNDS

FOR CITY, GRADED, AND RURAL AGRICULTURAL SCHOOL DISTRICTS

BY

WILFORD L. COFFEY
Deputy Superintendent of Public Instruction

Bulletin No. 52

Published by
The Superintendent of Public Instruction
1922

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STATE OF MICHIGAN

Department of Public Instruction

LANSING

To Those Interested in the School Buildings of Michigan:

For a number of years the laws of this state have required the approval of all building plans for school buildings before it is legal for boards of education to spend any money in their construction. As a result of the several years of experience in this work the Department has prepared this code. Architects, engineers, schoolmen, and builders have been freely consulted in its preparation. We believe that the result of our work should be of great assistance to those contemplating building. It is given to you with the sincerest hope that it will more than justify the work done upon it.

Faithfully yours,

Thomas E. Johnson
U. of K

February 1, 1923

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The Department of Public Instruction is indebted to many persons and to many resources for assistance in preparing this building bulletin for Michigan.

Several architects furnished the drawings of floor plans and photographs or perspectives of school buildings that have been constructed in Michigan. After the material for that part of the bulletin which relates to construction was ready for publication, the principles and units involved in it were submitted to all the architects of whom we had a record who had constructed school buildings in this state since the passage of the building law in 1915 for their constructive criticism. Many of these architects went over the material carefully and wrote us frankly about any statement where there might be a difference of opinion, giving reasons for their opinion. Such constructive criticism has been very helpful in preparing this bulletin.

Published works and reports of the committees of the National Education Association which have made a study of schoolhouse construction have furnished material out of which we have formulated principles herein set forth.

City and graded school superintendents, principals, and special teachers in such schools have been very helpful in furnishing data to aid in preparing the portion of this bulletin that relates to equipment.

Charles E. Greening of Monroe, Michigan, furnished for us the five plats of school grounds, illustrating how school officials might make school grounds beautiful and artistic. A questionnaire sent out to the superintendents of schools in city and graded districts by the Department of Public Instruction showed that the school grounds of Michigan could nearly all be classified under one of the five areas illustrated in this bulletin. With this data at hand Mr. Greening prepared the plats. He also secured for us the photographs of school grounds which we have included. His contribution should prove a valuable aid to school officials.

The parts of the bulletin relating to special phases of school organization and education have been prepared under the advice and assistance of members of the Department of Public Instruction. George N. Otwell, Superintendent of Rural Education, either advised in the preparation of or prepared that part relating to Rural Agricultural Schools and rural education; Floyd A. Rowe State Director of Physical Education, in that part relating to physical education; Edward E. Gallup, Supervisor of Agricultural Education under the Smith Hughes Act, in that part relating to Agriculture under the Smith-Hughes law; Miss Ruth Freegard, State Supervisor of Home Economics Education, in that part relating to home

economics and equipment; and Kenneth G. Smith, State Supervisor of Industrial Education and Percy Angove, State Supervisor of Rehabilitation Education, in consultation with the following committee: Earl BeDell, Detroit Chairman; G. G. Price, Battle Creek; Frank McRea, Muskegon; H. Hollenbach, Bay City; A. D. Mason, Jackson, prepared that part of the bulletin relating to manual arts and industrial education equipment. C. Lloyd Goodrich, State High School Inspector and J. B. Edmonson, University High School Inspector, offered advice and suggestions concerning that phase of the bulletin that relates to high school administration. R. A. Loveland, the engineer for the Department of Public Instruction, prepared the sketches that have been used to illustrate type rooms and the type building for rural agricultural school districts and small graded school districts.

We wish also to acknowledge our indebtedness to others not herein mentioned with whom we have counseled.

W. L. C.

SUGGESTIONS TO ARCHITECTS

In submitting plans and specifications for the construction of school buildings, two sets of blueprints showing in detail the heating and ventilation, lighting arrangement of all rooms, and construction, together with the specifications, should be forwarded to the Department. After plans and specifications are approved one set of plans and specifications will be stamped and returned to the architect and the other set will be kept on file in the office.

The plans and specifications should show plainly door plans, elevations, size of rooms, size of openings, and the size of glass area. The sizes should be plainly marked with figures so that in looking over plans it will not be necessary to rely upon measurements according to the scale indicated on the plans. If the blueprints contain a column schedule, footing schedule, slab schedule if used, concrete beam schedule, wall schedule, room schedule, door schedule, and such other schedules as are necessary to give a first class working drawing, the plans may be easily checked without delay to the architect or the school district.

Points of the compass indicating directions must be given on plans so that we may know whether rooms where pupils are to be seated throughout the day are provided with either an east or west light.

A plat of the school site and the location of the proposed building should be furnished to indicate opportunity for additions to care for future growth of school population. Accompanying each set of plans there should be a statement of the number of pupils that the building is to house. This statement should be furnished by the superintendent of schools. He, or some one authorized by him, should work out very carefully the probable growth of school attendance at the particular building based on previous attendance from the particular portion of the district that the building serves. The adaptability of the building to the purpose for which it is intended should be very carefully worked out. Rooms where pupils are to be seated must not be planned so that they extend below grade.

It will be a saving to the architects both in time and money if we can go over the preliminary drawings with them before they have made their tracings. We shall be pleased to do this.

Appointments should be made in advance if you wish to consult with members of the Department for our work requires that we spend a part of our time in various parts of the state

SURVEY

A school building is erected to serve the educational interests of the community. Before such building is constructed it is therefore necessary that those planning it should know what the probable educational needs of the community are at the time of the construction and what they may be in the future. Not only should the number of inhabitants of the school district be determined, but also the age of the adult population in order that it may be known whether it is likely that there will be children to affect school population growth. The resources of the district should be known in order to determine the amount of money that can be raised by the district without causing an undue tax burden.

In order to know how to plan for the future growth of the school it is necessary that present and past school census, enrollment, and attendance be considered in order that the percentage of growth over a series of years may be known. The school loss and retardation are factors that will affect the size of the building, for the loss from school may be such that there is need for but a small amount of room other than that of the first few grades, or there may be such a percentage of retardation that there is likely to be congestion in certain grades if extra room is not provided.

The vocational interests of the pupils when they have finished school are another factor that will determine the building that is to be constructed. If the pupils enter professional work, more time will be given to the cultural subjects and the classrooms will therefore be built to meet these needs. If, however, the pupils enter vocations that pertain to the shops, the building should be constructed to place emphasis on training that will help the pupils to perform ably the labor carried on in the shop.

The census growth and the population growth over a series of years will determine the probable growth of the community, but the probable growth record is not sufficient if school buildings are to be suitably located. A careful analysis of the direction of growth is necessary. A map showing the location of present school buildings, and the location of school buildings as they should be to place the elementary schools, junior high schools, and high schools the proper distance apart and in the right relation to each other is a valuable aid to the best location of buildings. Such a method projects an ideal building system into which the schools of the district can be fitted and to which all new buildings may conform. Authorities seem to agree that the radius about an elementary school should not exceed one-half mile and that the radius of the junior high school should not exceed three-quarters of a mile. The same consideration

does not need to be given to the location of the senior high school, for pupils of the age of those in these grades can go a greater distance. However, an effort should be made to have the senior high school building located at a convenient place for the pupils who will attend the school. The superintendent of schools should have the survey of his school building situation completed previous to the employment of an architect.

EDUCATING THE PUBLIC TO FINANCE SUITABLE AND ADEQUATE SCHOOL BUILDINGS AND EQUIPMENT

Letters were sent to several superintendents of schools where schools had been recently constructed or were in the process of construction, asking them to state the methods that had been used to educate and arouse the public to finance liberally the construction of suitable and adequate buildings. A summary of their answers follows:

1. Have a systematic plan for persuading the people of the necessity of authorizing the bonding election.

(a) Present the need of the school and its probable cost to the Chamber of Commerce.

(b) Purchase space in the paper which serves the community and inform the people of the need for the school building.

(c) Get a photograph of the proposed school building and mail to every voter with a statement of the facts and figures that concern the need for the building.

(d) Organize a committee to work up sentiment.

(e) Provide a card system of every legal voter with "opposed," "doubtful," or "favorable," as the case may be, on each card.

(f) Have a committee to check off each voter on election day and see that those who are favorable to authorizing the bonding issue vote.

2. Get parent-teachers' associations and local improvement clubs to sponsor the building program.

3. Hold luncheons at the cafeteria of the building that is over-crowded, so that citizens may see the congested conditions.

4. Have the question of building discussed at the various social and civic clubs.

5. Organize committees to interview voters, so that those who are opposed to the construction of the new building or are doubtful as to its advisability may be convinced as to its need.

6. Interest the boys and girls of the district in the new building and get them working for it.

7. Hold programs throughout the district in the schoolhouses, having the children give the program, and plan as a part of this program to present the need for the new building.

8. Have the steps taken for securing funds lead toward a logical conclusion.

(a) Make a survey of the school district to be served.

(1) Prepare a population map showing distribution of people.

(2) Show the number of vacant lots to indicate possible growth of population.
(3) Show graphically the increase in population for the several preceding years.
(4) Show graphically the growth in school attendance.
(5) Make a comparative table showing growth in school attendance in other towns when good facilities have been secured.
(6) Show cost, method of payment, tax per $1,000 of valuation, and any other informational facts. Trust the people to do right when informed of the facts.

(b) Make a survey of present school facilities.
(1) Show crowded conditions.
(2) Show resulting number of failures due to over-crowding.
(3) Show courses that cannot be given.
(4) Enumerate the educational possibilities for the pupils if the bond issue is authorized.

Alexander Theisen's book, Publicity Campaigns for Better School Support, copyrighted 1921 by World Book Company, Yonkers-On-Hudson, New York, gives the following suggestions for carrying out a campaign for better school support:

I. Follow the fundamental principles for success in such campaigns

1. Build all on the proposition that the people of the community wish to do the right thing by the children and that they will make any necessary sacrifices to this end if needs are clearly and convincingly shown.

2. Make the good of the children the paramount issue, in particular subordinating to it all considerations of cost.

3. Let the school authorities appear to be speaking for the whole people on school matters and not in the interests of any special class.

II. Follow the principles of good argumentation

1. Keep the issues clear cut.
2. Have unity of action.
3. Avoid overdoing the thing.
4. Appear to leave it to the people to judge for themselves.
5. Count upon the pride taken in personal or organizational accomplishment, to get people to support a good cause.
6. Choose arguments that appeal strongly to influential bodies of voters.
7. Seek timely arguments and illustrations.
8. Each argument presented to any group should be thoroughly sound.

SELECTION OF AN ARCHITECT

An architect who has been granted permission to practice in Michigan is a professional man. He renders professional service in his calling, as a lawyer or doctor renders professional service in his calling. The selection of an architect is therefore based on other premises than the fee which he charges for his service. If a member of a school board wishes a physician to attend his family, or if he wishes an attorney to represent him in legal matters, he usually considers the value of such professional services as compared with the professional service that may be rendered by others whom he might employ. The selection of such professional service by a member of the school board or by any other individual is no different in principle from that which should be followed in the selection of an architect for the preparation of plans for the construction of a school building and the supervision of the work during the construction. Except where the public sentiment of a community may demand it, there is no good reason why a school board should select an architect by competition to construct a school building any more than it should select a lawyer by competition to conduct its legal business. If a school board wishes to consider more than one architect, it should do so by making inquiry as to ability, responsibility, and reliability.

The school board should visit some of the districts where the architect has constructed buildings to determine the kind of work that has been done under his supervision. It should make inquiry as to the relations that existed between the architect, the school officials, and the contractor during the constructing of school buildings.

Can the architect work with people? Does he look carefully after the construction work? Does his school building have a finish, or is the work slighted where it is not generally noticed by the public? Does he have a conception of school needs and ideals so that his school buildings are suitable for meeting these needs and ideals?

The architect should be selected before the bonding issue is submitted so that the school board will know the amount of funds needed for the building program. The architect who is qualified to do the planning of school buildings can render a valuable service to the board in working out the community's ideas in accordance with best school practice. His services are as valuable for the supervision of the construction of the building as they are for the preparation of the plans and specifications. It is therefore inadvisable for the school board to dispense with this supervision. It is also inadvisable for an architect in most instances to agree to prepare the plans and specifications with the understanding that he shall not assume the responsibility of the proper construction of the building.

There are three agencies besides the home that are concerned in the construction of school buildings: the architect, who prepares the plans; the school district, acting through its board of education, which furnishes the funds; and the state, acting through the Department of Public Instruction, which approves the plans. These three agencies can best assure suitable school buildings if the planning and the construction of the school building is under the direction of a reliable and competent architect.

TYPES OF BUILDINGS

The school organization will determine the kind of building that is to be constructed. No school building should be planned without consulting the superintendent of schools as to the nature of the work to be carried on in the building. Michigan has school districts that will have need for the five general types of buildings; grade buildings, high school buildings, combination grade and high school buildings, junior high school buildings, and vocational school buildings. If the district is large enough to require grade buildings, junior high school buildings, and high school buildings, the planning of school buildings will be different from that required for a school district where one building must serve all the school needs.

A school building for the elementary school should be limited to two stories with both of these stories above grade. In such a building the heating plant, coal room, gymnasium, locker, and shower rooms may extend below grade if fundamentals are not sacrificed nor neglected. By using a construction of this kind all schoolrooms are made available for the seating of pupils. There is no reason why elementary school children should be required to work in rooms that are partly underground, even though those rooms are used for special purposes. A cellar is not a good place in which to develop healthly children.

A high school may consist of three stories. The first story or ground floor may be slightly below grade if the recitation rooms are given the same consideration concerning light, ventilation, and arrangement as the rooms on the other floors. The plan and interior arrangement will depend upon whether the high school is a four-year high school, a senior high school, or a junior and senior high school combined. The building must be planned to serve best the interests of the community where it is constructed.

Combination grade and high school buildings are designed for school work of all the grades from the first to the twelfth grade. Such buildings may be three stories, but the plan should be such that the pupils of the grades of the elementary school are as nearly separated from the pupils of the high school as can be in such a combination building. The elementary school should be cared for on other than the third floor. The serving of two general classes of pupils makes the planning of such a building important. The grade rooms where pupils are seated throughout the day will need to be planned to give either an east or west unilateral light.

The junior high school has come into existence because of the feeling that the four year high school has not been well adapted to the needs of the pupils. The promoters of the junior high school have had in mind
hool that would be better adapted to help the pupil make the trans-

ition from the methods and practices of the elementary school to those of the high school. The aim of this school is prevocational rather than vocational. This school offers a variety of work so that the pupils may find there those things that will appeal to their varying interests and aptitudes. This school gives the pupil a wide variety of contacts in order that he may wisely select his career. It is planned to take into consideration the individual differences that exist in our student body. The courses of study are usually organized for the purpose of carrying out the following objectives as given by the Committee on the Reorganization of Secondary Education:

1. Health
2. Command of the fundamental processes
3. Worthy home-membership
4. Vocation
5. Citizenship
6. The worthy use of leisure time
7. Ethical character

To achieve these objectives in the junior high school and give a variety of contacts there needs to be a curriculum that will provide for work in physical education, composite English, mathematics, foreign languages, science, social studies, history, civics, practical arts, commercial work, agricultural arts, music, drawing, art, and manners and morals.

The junior high school building should be planned so that these objectives may be realized in an economical manner both from the standpoint of cost of construction of the building and the pupils' and teachers' time and effort.

There have been constructed in the state the various types of buildings mentioned above. School officials will find it profitable to visit some of the districts having the particular type of building that they are interested in before deciding upon the plan of the school building which they are to construct. Plans and photographs of some of these buildings are given in this bulletin. These plans are not given with the idea that they are best in every particular. In fact some of them could be improved. These plans will, however, help you in working out your building problem.

A beautiful, well adapted building located on a site that is sufficient in size for the play and physical educational activities of the community is the kind of school building that a school district should aim to provide.

The recognized need for training for industrial work has caused the appearance of the vocational school as a part of our school system in the larger cities. A type of building somewhat different from our day school has been constructed. The same general principles of construction, however, are followed in the vocational schools, for buildings which meet the needs of day schools are usually suitable for vocational work. If the number of persons who are to do strictly vocational work is not sufficient to require a separate building the work may be done in the regular school building. Old buildings poorly lighted, heated, and ventilated are no more suitable for vocational work than they are for other school work. The building should be heated, ventilated, and lighted with as much care as an ordinary school building is heated, ventilated, and lighted. Since good light is essential in much of the shop work the rooms should have a minimum of light equal to one-fifth of the floor space. If the difference in the character of the work pursued makes it desirable that the vocational work be separated from the regular school work, provision should be made for as desirable rooms as the schoolrooms of the day school.

The vocational school building should be located on a site that is ample for its growth and as near the industrial center as may be. There should be rooms for mechanical drawing, class instruction, and laboratory work, as well as shops. The building should be planned with the idea of carrying on a particular trade or industry. Each trade or industry should be assigned to a particular portion of the building. In smaller cities a general shop in the high school building providing for household mechanics and two or three or more industrial activities is very satisfactory. In such a shop a general industrial course may be taught. An auto shop should always be near the machine shop and so built as to allow a car to be run in upon the floor.

The room in which related instruction is given should be near to the room or rooms where the related trade or industry is carried out. If the school is to train for industry, it must be planned and equipped so that the pupils are placed in situations closely resembling the industry for which the training is given.

Equipment

The vocational school departments should be equipped with the latest and best machinery and apparatus so that the class of work done by the pupils may be on a par with the class of work of the regular schools and the industrial work of the shops. Machines should be provided with safety

devices in accordance with the specifications of the State Department of Labor and Industry.

The boy or girl who takes work in a vocational and industrial school should have no difficulty upon going into a shop because of antiquated machinery used in the school. It is better that the industrial training be given in the shop and the school work in the school than to take work in a vocational school that is not modern in its education and industrial equipment and methods.

Before planning a vocational school building or department or general shop and the purchasing of equipment for it, the State Director of Industrial Education should be consulted.

BUILDING

GENERAL CONSTRUCTION

Ends Sought

Every school building should be constructed with the idea of serving public needs, as well as school needs. The people of Michigan who have given of their money to construct schoolhouses have not had the return from their investment that they might have had if more consideration had been given to serving the community socially as well as educationally. The schoolhouse should be the center of the educational, social, civic, and cultural activities of the community. The library, auditorium, and gymnasium, together with the domestic science equipment offer an excellent opportunity for civic and social organizations to carry on activities that directly affect not only the lives of the adult population of the school district, but the school population as well.

The auditorium provides a place for lectures, literary societies, farmers' clubs, and women's clubs as well as school activities which enrich the school curriculum.

A school building should be beautiful without sacrificing fundamentals. It should be placed in beautiful surrounding for aesthetic value. It should be constructed with due regard for hygienic principles. Such factors as safety, utility, durability, and economy of construction are fundamental.

A school district in the construction of a school building should avoid such defects as poor design and insufficient land for the proper setting of the building. It should not construct a building that is unfitted to the function it is to perform; that is so inelastic that it cannot be altered to meet the change in school ideals; that does not lend itself to additions, or assembly and reaction purposes; that is costly because of several idle or oversized rooms, corridors, and halls; that is insufficient in illumination, either natural or artificial; and that has improper accoustical properties.

The school building is one of society's means of advancing civilization. Democracies have recognized that their safety, prosperity, progress, culture, and happiness are dependent upon provision for the education of every child, regardless of his financial support. This fundamental need for education makes it necessary that there be adequate school facilities, and that the unventilated, poorly lighted, poorly constructed, and poorly equipped schoolhouse of the years gone by should be discarded just as our machinery, our tools, our means of transportation, and our inadequate business methods have been discarded for those that are in harmony with the spirit and ideals of this age.

MATERIAL

A school building may be constructed of material that will make it fireproof, or semi-fireproof, or it may be constructed of material that is not fireproof. A school building should be fireproof if a large amount of money is expended in its construction, for it means permanency of structure, better hygienic conditions, reduction of repairs, elimination of danger of destruction by fire, freedom from shrinkage, and less heat losses.

A building is considered fireproof if the walls, floors, partitions, ceilings, piers, columns, roof, stairs, and corridors are constructed of incombustible material and the metallic structural material is protected by an incombustible fire-resisting material. Such covering may be brick, tile, portland cement, terra cotta, or other fire-resisting material of sufficient thickness. A building is considered fireproof even though there are wood trim and wood floors. The rules prescribed by the National Board of Fire Underwriters should serve as a guide in determining whether a building is fireproof.

All school buildings, the construction of which is not in accordance with the requirements of a fireproof building, are non-fireproof, although there may be some fireproof construction. School officials should not be misled by the statement that a non-fireproof building is as good as a fireproof building. It is not.

STANDARDS AND ARRANGEMENT

The real purpose of the school building is to furnish means for promoting educational work. It is essential, then, that a high percentage of the school building be available for instruction.

The divisions of school buildings and their relative value resulting from a study made by a committee of the National Education Association are as follows:

Division	Floor area
Administration	not more than 12 per cent
Instruction	not less than 50 per cent
Accessories	not more than 3 per cent
Stairs and corridors	not more than 20 per cent
Flues	not more than 5 per cent
Walls and partitions	not more than 10 per cent

These divisions were arrived at for the purpose of giving some basis of determining whether a school building is planned with a maximum space for instructional purposes and a minimum space for the other purposes which must be provided in the school building. Fifty per cent for instructional purposes is low. Our best school buildings constructed in recent years have more than this. A mathematical carrying out of these divisions will not necessarily mean a good school building.

It is the business of those planning schoolhouses to keep in mind the fact that the instructional part is the important part to be considered, and that the other divisions must be kept at a minimum; otherwise the taxpayers' money is being wasted.

The adaptability of the plan in meeting educational needs, its safety, its provision for sanitation, its workable arrangement of rooms, its size, location and accessibility of the auditorium and gymnasium, its provision for physical education, its library if used by the public, its laboratories, and its vocational and pre-vocational facilities are factors that must be considered in preparing plans for a schoolhouse.

CLASSROOMS—ELEMENTARY SCHOOL

The size of the classroom should be determined by the number of pupils to be seated in the room. The classroom should be planned with a minimum of fifteen square feet of floor space per pupil and an air space of two hundred to two hundred fifty cubic feet per pupil. This air space per pupil is the determining factor for the seating capacity of a classroom, even though the floor space on a basis of fifteen square feet of floor space per pupil would permit more pupils to be seated in the room. It should be an exceptional case or a room for special work, which is larger

than 24′ x 32′, except special classrooms such as kindergarten and industrial art laboratories. The ceiling height should be not less than twelve feet. The width of the room should be not more than twice the distance from the floor to the top of the windows used for lighting the class room. A classroom 22′ to 24′ by 30′ to 32′ with a ceiling height 12′ to 13′ will be about the right size for most school buildings. Exceptions may be taken to these sizes in school systems where there is an opportunity to control the number of children that will be placed in any schoolroom. In such school systems the rooms may be 20′ x 30′ and 22′ x 28′, with a ceiling height of 12′.

RECITATION ROOMS—HIGH SCHOOL

The recitation rooms for high schools have no standard size. Their size depends upon their use. There should be recitation rooms of different sizes so that there will be sufficient room for those classes that are large because of the subjects pursued. The recitation rooms that have been planned for Michigan high schools vary from 15′ x 20′ to 24′ x 32′. A recitation room should not be larger than is necessary to accommodate the class. Recitation rooms that are larger than this are not only a waste of money at the time of construction, but also a waste of money for maintenance as long as they are used.

The classrooms for the same or similar grades should be placed near each other. The kindergarten and first grades are similar. They should be near each other. The smaller children should be near the exits. If the first six or eight grades occupy two floors the lower grades of these should be on the first floor.

The architect, school board, and superintendent planning a classroom should keep in mind economy consistent with the purpose the room is to serve, and the standards essential for a safe, sanitary, and durable construction.

WARDROBES

There are at the present time three classes of wardrobes in use in Michigan schools: front, rear, and side. The front and rear are usually arranged with two open doorways into the classroom, one at each end. However, wardrobes with vanishing, rolling, or swinging doors are arranged at the ends of the schoolroom as well as on the side of the school. If such wardrobes are used, they should be of such depth that the children's wraps can be hung in them without being closely packed together. This is necessary for sanitary reasons. Provisions must always be made for the proper ventilation of these rooms. Sometimes screened steam coils are placed at the base of the wardrobes to dry any damp clothing that may be placed in them. If the wardrobe with the vanishing, rolling, or swinging door is placed at the end of the building, attention must be given to its

location so that it will not be at the front of the schoolroom, for there is no suitable provision for blackboards at the front of the schoolroom where a part of them should be.

Wardrobes made by partitions across the end of the room with an outside window into them give more space for the hanging of wraps and are usually to be preferred where there may otherwise be a placing of wraps one above another. They are more expensive to construct for they add four to six feet to the size of the room and thereby increase the outside dimensions of the building. Corridor lockers are frequently used for grades above the first two instead of wardrobes.

ASSEMBLY ROOM

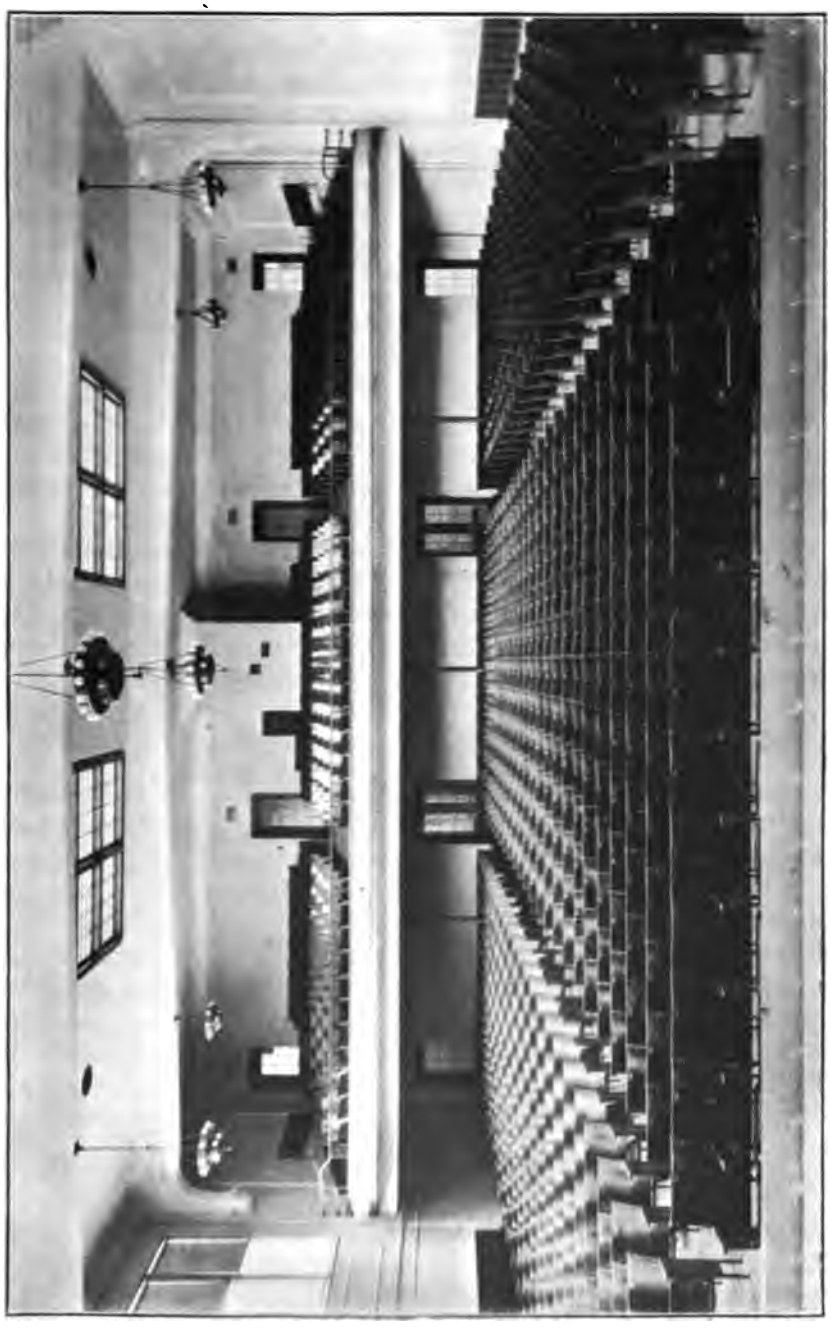
In most high school buildings that have been constructed in the past provision has been made for an assembly room where the ninth to the twelfth grades are seated. With the introduction of the junior high school we have had the assembly room seated with grades from seven to twelve inclusive in the smaller school systems, and with grades seven, eight, and nine, or ten, eleven, and twelve in the larger high schools. Recently there has been a movement away from the large assembly room to the study room of smaller dimensions. The organization of city systems is such that such an arrangement can be carried out, but the school systems with a total school population of five hundred or less and maintaining but one school building will find it an advantage to retain the assembly or large study room, as a home room for the pupils. This room usually serves as a place where classes may be conducted. It may also serve as a place to carry out the community center movement.

AUDITORIUM

The auditorium is an essential feature in any modern high school of considerable size. It should be constructed with a stage for choruses, mass drills, symphony orchestra, school plays, literary work, club work, debating, and other forms of student activities.

This room should be well lighted, heated, and ventilated. It should be on the first floor so that it can be easily reached by the public, for the auditorium should serve as a meeting place for community activities.

Inasmuch as such a room will often be filled with people careful provision should be made for exits. It should be arranged so that it can be shut off from the rest of the building for use during school sessions without disturbing the school. This room should be wired for lantern and moving picture machine and the windows should be arranged so that the room may be darkened if pictures are to be shown during the day. The trend toward the use of the lantern and the moving picture for school instruction makes it necessary that the auditorium be available during the



Auditorium, Benton Harbor High School, Benton Harbor, Michigan

school sessions. Special attention should be given to the accoustics of this room.

In the smaller schools the function of the auditorium and the gymnasium should be combined. The gymnasium can be seated with chairs for auditorium purposes and the chairs stored in a room adjacent when the gymnasium is used for other purposes. If the school district cannot afford either a gymnasium or an auditorium, the assembly room may be used for community activities as well as for school purposes.

STUDY ROOMS

If an assembly room is not provided, there should be a study room in schools maintaining the high school grades. This study room will vary in size depending upon the number of pupils to be accommodated. The study room may be made to seat as many as two hundred pupils. It is better to have more than one study room than to make the study room too large. A study room for seventy-five to one hundred pupils is better than one that is larger.

The study room should be adjacent to the library so that pupils may have easy access to books needed. The library, however, may be located acress the hall from the study room. Often it is located between two study rooms. These rooms should be arranged so that there is a minimum of stair climbing when the pupils are going to or from classes.

OPEN AIR ROOMS AND MUSIC ROOMS

Every grade school building containing several rooms should have at least one open air room. This room may be any room of the building, but the best location is a southern or eastern exposure. The windows should be arranged to keep out the storm and still admit the maximum amount of sunlight and fresh air. The room should be located so that there is easily accessible a place for the preparation of the forenoon and afternoon lunch. Toilets, wardrobes, and lavatories with hot and cold water should be on the same floor as the open air room.

The music room should be located in that part of the building where there will be least disturbance to other departments. Ample provision should be made in the construction for the reducing of noise from this room.

KINDERGARTEN AND FIRST GRADE ROOMS

The kindergarten room should be a large, well-equipped, and well-lighted room. One and one-half to two classrooms is about the right size. It is well to have a fireplace at one side. It is important that the room be large enough to give room for playing games and for folk dances. It is advisable to have this room located on the east or south side of

the building because of the cheer furnished by the sunshine. There should be a toilet room and lavatory off the kindergarten room. It is also well to have a drinking fountain in the room. Drawers and cases for the pupils' work should be provided. The cupboards and drawers for the pupils' work should be low. The blackboards should be placed low enough for pupils' use. The windows should be large groups with built-in window seats and placed low so that the pupils of the kindergarten age may enjoy them. Every effort should be made to have this room a beautiful and attractive place for children because their first school contact is here. It is, therefore, important that they form the right impression of what school offers them. The provisions for the first grade room may well be according to those recommended for the kindergarten room since the children who occupy these two rooms have may interests in common.

SCIENCE ROOMS

The arrangement and equipment for this branch of the school course will depend upon the size of the school and the ideals of the community which it reflects. The laboratory should be of ample size to allow pupils opportunity to work out unhampered any experiments assigned. The room should be equipped so that it may be darkened for lantern lectures. The science department is an important part of our school because in this age of industry men and women with scientific knowledge are in demand. Whatever may be done should be done in furtherance of our industrial and commercial life, as well as reflecting the ideals of our social life.

The ground floor if properly lighted, unless it is a basement room where the equipment will rust or corrode, is a good place for the sciences, for there is less vibration to affect delicate instruments. The location of these rooms, however, may depend upon grouping them so that they may be easily reached by the pupils who use them.

There should be proper ventilators to discharge the fumes, and the pumping should be of the best. In the small school the lecture room can be used for both chemistry and physics. In such case the lecture room should be placed between the two rooms. The chairs in the lecture room should be tablet arm. There should be ample cases for all materials and equipment needing protection.

GENERAL SCIENCE ROOM

The general science room should be arranged so that supplies are accessible. There should be ample tables for individual study and activity, and equipment for individual work without interference from other pupils. The room should be provided with the equipment and apparatus

essential for the best school work. The equipment and apparatus should be selected so that there will be opportunity for constructive work by the pupils with the idea of developing thinkers.

BIOLOGY ROOM

The biology room should have an abundance of light because of the microscopic work that must be carried on there, and there should be arrangement for abundant sunshine if plant and animal life are kept for observation. There should be suitable work tables and chairs for the pupils, cases for the apparatus and equipment, cases for the material used for study, and gas and water.

PHYSICS AND CHEMISTRY ROOMS

The physics and chemistry laboratories, if separate rooms, should be arranged with a common lecture room between them except in a large school system where it is deemed necessary to have separate lecture rooms. Each laboratory should have storeroom for apparatus and supplies. There should be ample cases for storing all physical and chemical apparatus and supplies. The lecture room should open into the two laboratories and into the corridor. It should be provided with a demonstration table for the teacher with water, gas, and electrical connections. There should be blackboards in the lecture room and in both of the laboratories; also a bulletin board. The windows should be arranged so that they may be darkened for lantern work. The physics room should be provided with a dark room. Care should be used to provide ample gas burners and desks for the pupils who use the laboratory. Pupils will not do their best work if they must work under crowded conditions. There is also danger in crowded chemistry laboratories of the pupils spilling acids on one another. There should be at least one sink for every two pupils in chemistry. In the other sciences the number of sinks installed in the room will depend upon the number of pupils in each class taught there. Ample plumbing for these rooms should be provided at the time of the construction. There should be one or two sinks in the photographic dark room, prefereably two. The desks installed for physics and chemistry should be provided with glass, soapstone, or wooden tops. There should be hoods for carrying off the gas fumes, and reagent shelves for holding reagent bottles. There should be sink connections in the floor and electric outlets to care for the artificial light and electric current needed for chemical use.

AGRICULTURE ROOM

The agriculture room should have preferably a southern exposure and be located where there is ample light and freedom from freezing

temperature. In no case should the exposure be north. The agriculture room should have a solarium in connection with it, or it should have some other means of providing a place for growing plants for observational and study purposes. See page 208 for suggestions for an agriculture room.

HOME ECONOMICS ROOMS

The school building is not complete without provision for home economics. Girls need training in this subject not alone because they need to know how to sew and cook, but because they need to know how advantageously to manage a home. Home economics should be taught in rooms efficiently equipped and conveniently arranged. Standards for selection of home equipment as well as standards in neatness and convenience in the home necessitate the establishment of a department organized with these standards in mind. Cooking and sewing rooms require as much light as any rooms in the building. The practice, therefore, of placing this science in basement rooms unfitted for other school purposes should be abandoned. These rooms should be well ventilated, the floors should be wood or other material that has proved satisfactory for school purposes. The size of the room will depend upon the number of pupils to be taught in it at any one time. The ordinary standard room of 22 to 24 x 30 to 32 feet will be ample space for twenty pupils for either sewing or cooking. This means that an allowance of about 30 square feet of floor space should be allowed for each pupil in this class. The home economics rooms may include sewing room, fitting room, kitchen, laundry, storeroom, and dining room. The rest rooms which are provided may well serve as rooms where instruction may be given in the art of bed making and the care of equipment usually found in the home bedroom. The smaller school buildings will have these rooms in proportion to the time that can be given to this phase of school work. The small school building where only one home economics teacher will be needed may arrange the equipment for cooking and sewing in one room. This room should be the size of one and one-half classrooms in length and a classroom in width. The rooms for domestic science and domestic art should be arranged so that there may be economy of effort in carrying out the work.

A practice house where people live is highly desirable in conjunction with laboratory rooms for food and clothing work. However, the following rooms will very well provide space for the best type of home economics training:

Food laboratory with storage space or storeroom
Clothing laboratory with fitting room and storage space
Dining room
Bedroom with first aid equipment

Bath
Laundry room with recitation facilities
Living room for conferences and class work

COOKING LABORATORY

There should be a well equipped kitchen with storage facilities. If possible a dining room should be provided for practice in serving meals. This room need not be large but it should be furnished for a standard of living suitable for the majority of the group using it. A combination kitchen cabinet and buffet may be built in the wall which separates the kitchen and dining room, or a pantry may be provided. At least one unit kitchen should be arranged either in the laboratory or in a separate kitchenette. It should be equipped to be convenient and adequate if transferred to a home. For this reason, it is advisable to furnish the units on the basis of varying costs to meet the financial and social conditions of the community and at the same time present good standards. Each unit provides working space for all types of cooking; additional cooking desks of the laboratory type should be provided. Three units of varying costs are recommended with sufficient conventional laboratory food desks to accommodate the class. The unit kitchen may be arranged by having a work table or desk and sink conveniently placed in relation to the stove. The storeroom should be placed where it can be easily reached from the instructor's desk and supply cupboards should be provided. Table space should be arranged for each pupil. There should be a four to six hole range besides the hot plates and ovens provided for the pupils and the hot plate provided for the demonstration table for the teacher. In a large school it is well to provide a model laundry fitted with three section laundry tub, electric washer, electric irons, and boards. Schools are making additional use of laundries in caring for lunchroom towels and gymnasium towels and garments.

The domestic science department offers an opportunity to do much in training girls to be expert housekeepers and home keepers. For this reason every facility for this training should be provided. It is well to plan a corner room for a kitchen in order that there may be cross drafts for driving out odors. It is also well to have this room on the side of the building where it can be reached by the prevailing winds to make it cool during the warm days. An icebox, sinks, and lavatory should be provided for the room. The sinks and drain boards should be about 34 inches from the floor. Lockers for aprons and storage space for clippings, charts, and bulletins are necessary. A blackboard and a low vertical bulletin board should be provided. See page 167 for suggestions for a cooking laboratory.

SEWING LABORATORY

A sewing room should be located where the unilateral lighting will be at the north side. The room should be provided with built-in closets about 18 inches deep and provided with rods from which clothes may be hung. There should also be individual lockers so that each girl may have her own locker in which to keep her work. There should be an ironing board recessed into the wall and a fireproof place to keep the electric iron. There should be a lavatory accessible to this room. The wall finish should be a light shade in order to insure the best effect of either natural or artificial lighting. The built-in cabinets for sewing material should be long enough for the longest garments that may be hung in them.

There should be storage space for clippings, magazines, charts, and lengths of standard fabrics. The blackboard and vertical bulletin board should be placed in sight of all the class. See page 172 for suggestions for a clothing laboratory.

LUNCH ROOMS AND CAFETERIAS

A special place should be provided for serving hot lunches. The ground floor is usually the best place to locate such a room. The lunch room and cafeteria should be adjacent to the cooking laboratory unless there is a special kitchen and serving room for these rooms. If the cooking laboratory is used, a stove and work table should be convenient to the lunch room so as not to interfere with other work going on in the class. Nearly every school system has children who eat their dinner at the school building. The lunch room and cafeteria may serve an important function in providing a place where these children may have a wholesome warm mid-day meal, or where they may supplement the packed lunch.

LIBRARY

The library is an essential part of school construction. It is as important to good school work as any of the science rooms. It is important that pupils have an opportunity to secure training that will give them a good idea of history, economics, sociology, literature, education, industry, and art. The size of the library room and the equipment will depend largely on the size and kind of school. In the larger school systems there may be provision for lecture room and stack room and seating capacity for the number of pupils that may need to use the library at any one time. The library should be near those rooms where pupils who must do library work are seated. If there is a study room or assembly room it should be located so that pupils may go directly from the study room or assembly room to the library. The library should also have a doorway into the corridor so that it will be accessible to the pupils of other

rooms. The library room may be near the study room with provision in the study room for the books generally used by the students of the study room.

The community needs should also be considered when placing the library room. A school library, unless there is a separate public library, should be for the use of the public as well as the school. The room, therefore, should be easily accessible to the public. The room may be on any floor so long as it is well located for school use. The first floor, however, is the best location if the public has the use of the library room, and a separate entrance for the public should be provided. The pupils' use must have first consideration in locating the room. It is imperative that the use to be made of the library is the dominant factor to be considered in its planning, location, and equipment. The library room should be well heated and ventilated. The location of the heating units, vent ducts, and fresh air ducts should be carefully considered not only for the heating and ventilating of the room, but also that they may not interfere with the location of book shelves. The floor of the room should be battleship linoleum or cork tile, and the doors should be provided with checks to avoid noise. The room should be well lighted by both natural and artificial light. The shelving should be around the outside of the room so that the center may be left for tables and chairs. The tables should be of the proper height for the pupils who are to use them and there should be a sufficient number to insure a pupil's doing his work without the interference of other pupils.

The ceiling, walls, and trim should be finished in colors that will give the best lighting effect. Light cream for ceiling and buffs, tans, and grays are good colors for side walls. The trim should be a color that harmonizes with the color used on the walls and ceiling. There should be space for pictures and sculpture. The library room offers an opportunity for the school to teach art and refinement, through its decoration, equipment, and furnishings without detracting from its utility.

COMMERCIAL ROOMS

The commercial department in the larger school systems should have a bookkeeping room, shorthand room, and typewriting room. The bookkeeping room should be equipped with a bank so that business can be handled in a manner similar to that of outside business. The shorthand room should be fitted with desks for general work connected with the commercial department. The typewriting room should be fitted with the regular typewriting office desks with disappearing tops so that the machines can be kept cleaned and locked so that no one can interfere with them. The typewriting room should be separated from the shorthand room by a glass partition so that both rooms may be under the

control of the instructor at the same time. The commercial rooms should be located so that they are adjacent.

MANUAL TRAINING ROOM

The manual training department of a school system will depend upon the size of the school and the courses of instruction that are to be taught. The room or rooms where this phase of school work is taught should be as well lighted and heated as any classroom in the school building. See page 200 for suggestions for size, arrangement, and equipment of rooms used for manual training and shop purposes.

ADMINISTRATION ROOMS

The administrative department may include superintendent's office, reception room, school board's room, vault for records, and adequate space for clerical help.

SUPERINTENDENT'S OFFICE

The superintendent's office should be large, well lighted, heated, and ventilated with private toilet and cloakroom. The average school may combine the superintendent's office and the board's office. The superintendent's office should be located near the front entrance where the public can easily find it and where it can be easily reached from every part of the building. There should be a reception room adjacent to the superintendent's office so that those wishing to consult with him may have a place to wait if he is busy. The reception room as well as the office should be well lighted. Both rooms should be provided with chairs and such other furniture and equipment as may be necessary to make them attractive and efficient. The vault should be located where it will not be possible for any one to reach it without going past some one in the office. Much care should be used by the school board to provide a first class office and administrative department for the superintendent. He should have the equipment and furnishings necessary for conducting the school's business in a businesslike manner.

PRINCIPAL'S ROOM

The principal should have an attractive office where he or she may meet pupils, teachers, and patrons. In a larger building the office should have an outer reception room. The principal's office should be located where it can be easily reached by teachers and pupils and where it will be best situated for administration of school activities during intermissions. This office should be provided with toilet room and cloakroom adjacent. There should be a small storeroom or cupboards for storing material in connection with the office.

DEPARTMENT OFFICES

In the large schools there should be offices for the heads of departments where these heads may do the planning of their work and where all records connected with their daily work may be kept. Their offices need not be as elaborate as that of the superintendent or principal, but they should be well lighted, heated, and ventilated, and equipped with furniture and apparatus for carrying out the work.

TEACHERS' ROOMS

There should be provided in every school building containing several rooms a small room for the men teachers and one for the women teachers, where they may meet their pupils for consultation if their own classroom is in use, and where they may retire when not actively engaged in some school work. This room should be provided with lavatory and toilet adjacent. It should also have comfortable rockers, couch, table, rugs, bookcase, towels, and other comforts. It is well to have the teachers' restroom located near the principal's or superintendent's room, so that its use by teachers may be supervised. This room, however, may be located elsewhere. The rest room for teachers if properly supervised as to its use will repay its cost to the school district.

GIRLS' REST ROOM

The girls of the school should have a small rest room. This room should be adjacent to the lady teachers' rest room with a doorway between the two rooms for the purpose of supervision. The room should have a lavatory and toilet and should be provided with a first aid outfit unless there is a nurse's room with this first aid equipment. Besides this equipment, it should be equipped with table, couch, chairs, towels, and such other equipment as may be necessary to carry out its purpose. The room should be properly lighted, heated, and ventilated.

DISPENSARY ROOM

Every school building of any size should make provision for the school nurse, oculist, dentist, and school physician, if either or both are employed or likely to be employed in the future. School buildings are constructed to last a half century or more. For this reason it is advisable to make arrangement for those school activities that are likely to be carried out in the near future. The importance attached to physical education and health education requires that careful consideration be given to a place in the school building for this administration. The walls and ceiling of this room should be painted white so that they can be

easily washed. There should be a lavatory, toilet, vitreous china sink, hot and cold water, and a dressing room. The room for the oculist should be the regulation length of 20 feet or more. The room should be equipped with couch, scales, medicine cabinet, table, waste basket, and chairs.

JANITOR'S OFFICE

The janitor should have a comfortable office. His long hours of service make it necessary that he have this consideration. There should be a toilet room and wash room adjacent to his office and his room should be located near the furnace room. His office should be of good construction with good floor and walls and equipped with desk, filing drawers, and chairs. The fire alarm and the telephone from the principal's or superintendent's office should connect with his room.

CLOSETS AND STOREROOMS

There should be closets in connection with the laboratories and home economics room for storing and keeping material and apparatus. Every school building should have plenty of storerooms. If the material to be stored is inflammable, the storeroom should be fireproof. Under no circumstances should storerooms be located under stairways, corridors, or exits.

CORRIDORS, ENTRANCES, AND EXITS

The arrangement of corridors, exits, and entrances is important to give balance to the building as well as to provide for utility, convenience, and safety. The corridors must be of sufficient capacity to allow pupils to pass quietly and in an orderly manner from one part of the building to another. Economy of construction should not be carried far enough to produce danger because of width of corridor. A minimum of ten feet in width should be allowed in all corridors used for the passage of pupils and this width should be increased to care for the number of pupils that are necessarily in the corridor at any one time. The corridors should lead to exits. They should have direct light in them and the ends should not be blocked off for offices, toilet rooms, or other rooms. There should be at least two inside exits from each floor and from the corridors to out of doors in all school buildings of more than three rooms. The placing of corridors and exits should be made with the idea of providing a safe outlet from the room in case of fire as well as an aid to the administration of the school. The walls of the corridor should be finished with some material such as cement and hard wall finish for five or six feet from the floor where they receive their hardest usage. The rest of the walls and ceiling may have the same finish as any other part of the building.

The floor of the corridor should be made of material that is reasonably free from noise, permanent, and easily cleaned. It should be of some fireproof material in fireproof buildings. Terrazzo, mastic, battleship linoleum, and cork tile are being used at the present time. Wood may be used but it is not so satisfactory since it is more difficult to keep clean. Cement should not be used for corridor floors even if it is painted.

The base to the corridors should be rounded next to the floor and flush with wall above for cleanliness. If wood base is used, there should be a cove or quarter round next to the floor to prevent the accumulation of dirt next to the base.

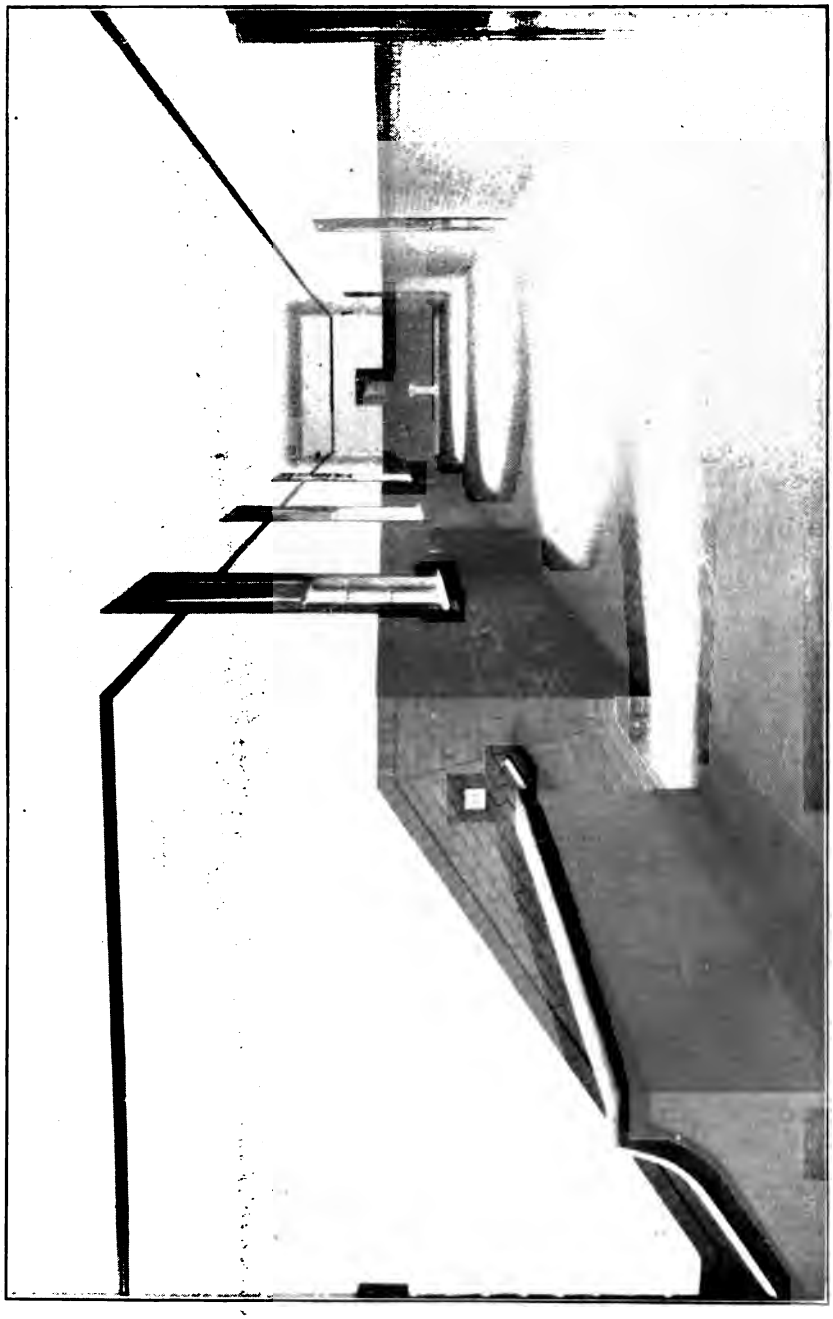
Exits should be planned for the safety and convenience of the pupils. The number and location of exits should be such that if any exit is blocked another one will be available so that danger of panic or the entrapping of pupils will be avoided. There should be an exit at or near the end of every corridor and every stairway should lead to separate exit doors. The width and location of exits should be such that there will be no corners in which pupils may be trapped.

All assembly halls and auditoriums should have at least two exits. The number of exits provided will depend upon the number of persons who may be assembled in such rooms at any one time. These exits should be at the ends or at one end and a side so that there may be a quick emptying of the building in case of fire.

STAIRWAYS

Stairways leading to the upper floor should be at or near the opposite ends of the corridors. Sufficient stairways should be provided so that children can get out of the building in the usual manner if there is a fire. Do not depend upon fire escapes. The stairs should be either fireproof or slow burning material and supported by some form of fireproof material. It should be kept in mind that the stairways should be constructed for safety as well as utility. The doors leading from the stairways should open out. The width of stairways for the elementary and high schools should be from three feet eight inches to four feet two inches in width between hand rails so that pupils cannot march more than two abreast. This will give each pupil a hand rail, which must be provided on both sides of all stairways. If a stairway is wide enough for three pupils to pass abreast the center pupil does not have a hand rail and there is therefore danger in case of a panic. If stairs are made wider than the size given above, they should be made wide enough to double the width allowed and hand rails provided down the center so that each two pupils abreast will have hand rails.

Corridor, Muskegon Heights High School



Corridor, Henry R. Pattengill Junior High School, Lansing

Stairs must not be placed over boiler rooms, furnace rooms, or any other place where fire may originate and cut off the means of escape for those on the upper floor. The outside balustrades to stairways should be of closed construction where there is a run of more than one flight of stairs, for girls coming down the stairs are not well protected from the view of those on the lower flight of stairs. The open balustrades are not so easily kept clean.

If there is an elementary school, junior high school, and a high school in the same building there should be separate stairways for each so that the pupils of each of these school organisations will not be required to mingle on the stairways.

In the construction of a schoolhouse, the stairway should not be cheapened because of the lack of funds. The height of the riser and the run should be such that there is an easy climb. The riser should vary from 5 inches to 7 inches, depending upon the grades to be taught in the building. The width of the run will vary from ten to twelve inches depending upon the height of the riser.

Kidder's Architects' and Builders' Pocket Book, Seventh Edition, contains the following rules relative to treads and risers:

"For schools and for stairs used by children the rise should not exceed 6 inches. The width of the run should be determined by the height of the rise, the less the rise the greater should be the run and vice-versa. Several rules have been given for proportioning the run to the rise:

(1) The sum of the rise and run should be equal to from 17 to 17½ inches.

(2) The sum of two risers and a tread should not be less than 24 nor more than 25 inches.

(3) The product of the rise and run should not be less than 70 nor more than 75. These rules apply only to stairs with nosings. Stone stairs without nosings should have at least 12 inch treads for adults."

STAIR LANDINGS

There should be stair landings the width of the stairs half way to the next floor. These landings should be kept clear of seats, flower stands, or any other construction that might cause children to stumble or be pocketed in case of fire.

DOORS AND HARDWARE

Good doors should be provided for school buildings not only for their utility but for the finished appearance that they give to the school building. Cheap hardware should not be used. The hardware of a school building has usage that requires the best. The rooms should be provided with locks so that the teacher may lock her door if she wishes.

Locks to classroom doors should be such that they cannot be locked from the classroom side. A master key should be provided for the janitor and the superintendent or principal. If doors are to work well, care must be used in the construction of the building so that it will not settle. Besides providing panic bolts or their equivalent and locks for outside doors, there should be suitable door checks. Under no circumstances should there be top and bottom bolts to doors, except when controlled by panic levers. The doors to classrooms should be at the teacher's end of the room to give better control over the pupils of the room, especially in case of fire.

FLOORS

There is no part of the school building that should receive closer attention than the construction of floors. There are several kinds of floors that may be used in school buildings.

Tile floors are good for shower, locker, and toilet rooms and outside vestibule. They are also good for corridors and places where there may be exposure to storm. A tile floor, however, is hard, noisy, and cold. Terrazzo floors may be used throughout the school building. They are liable to crack, however, unless properly laid. They must be laid so that there is opportunity for contraction and expansion.

Battleship linoleum and cork floors are the most noiseless floors that can be laid. The floor upon which they are laid should be perfect if the wearing qualities are to be prolonged. These floor coverings should be cemented to the base upon which they are laid.

Mastic floors are now used in school construction. This material may be used in classrooms, corridors, halls, showers, and toilet rooms.

Hardwood floors are advisable for woodworking rooms where sharp tools are used. Wood floors are among the most satisfactory for classrooms where seats and desks are to be placed. If wood flooring is to be used, clear hard maple, side matched and end matched, 2 inches to 2¼ inches face, and securely nailed should be used. This floor should be floated on strips 2 inches to 3 inches wide by 2 inches thick with deafening beneath it. It is well to have this deafening extend back of the baseboard for a few inches. New laid wood floors should be sanded and filled before putting on a finished coat. If the floors are to be stained the stain should be put on before the filler. After the stain and filler have been applied, a sufficient number of coats of shellac should be applied and the floor finished with wax or a good floor varnish. Schoolroom floors may also be finished by coats of oil instead of filler and wax or varnish.

If floors are to be oiled, they should be thoroughly cleaned with hot water and some good cleansing compound before the oil is applied. This

should be done each time before oiling. Some good sweeping compound may be used when sweeping, but for sanitary reasons care should be used not to place this compound where it may lodge back of stationary seats.

Cement cannot be approved for finished floors for schoolrooms, corridors, or any other part of the school building that is used for school purposes.

PLASTERING

The plastering should be well done. The number of coats should be specified and the last coat should be trowelled to a smooth finish. A sand finish which becomes a catchall for dirt and germs should not be used. All exposed corners should have galvanized or copper corner beads.

PICTURE MOLDING

Every schoolroom should be provided with a picture molding so that pictures appropriate to the grade may be hung on the walls.

INTERIOR DECORATION

The school board at the time of construction of the school building should plan for the decoration of the walls. A school building is not completed if the proper treating of the walls is omitted. The color scheme used is important because it is directly related to the proper lighting of the schoolroom. The walls and ceiling should be painted so that they may be easily cleaned. The following combination of colors will be found satisfactory:

1. Side wall—cream
   Ceiling—ivory
2. Side wall—silver gray
   Ceiling—pearl gray
3. Side wall—buff stone
   Ceiling—cream

ROOFS

The covering on roofs of all school buildings should be of material that is fireproof or of slow burning material.

FIRE ALARM

Every building that is more than one story in height should be provided with a fire alarm system with gongs that can be heard in every room, including the basement rooms. The system should be tested at frequent intervals so that it may be known that the system is in working order. Fire drills must be given once each month according to law. They should be given oftener.

FIRE ESCAPES

Provision should be made at the time of construction for such fire escapes as are required by the State Fire Marshal. Every school building should be so constructed and arranged that there will be a feeling of safety if there should be a fire any place in the building. Such a feeling of safety will be a large factor in preventing panics and the injury and loss of life that are due to panics. Fire escapes are not good substitutes for fireproof inside stairs, corridors, and exits. They are an unsightly appendage to the outside of a school building and should in no case be erected to take the place of an inside stairway.

LIGHTING

WINDOW ARRANGEMENT

The amount of defective vision among children and adults is such that those who are planning school buildings need to study very carefully the proper lighting of the schoolrooms. The lighting must take into consideration both the natural and the artificial.

The ideal way to light a classroom is by unilateral banked windows. Rooms with north exposure should have a larger percentage of glass area than those with other exposure. Schoolrooms should be lighted so that the glass area equals at least one-fifth of the floor area of the rooms. The light should all come from the left of the pupil, and the light should be arranged so that the banked windows throw the volume of light across that part of the room where the pupils are located. The front and back rows of seats may well be taken as the distance windows may extend to the back and front of the schoolroom. The more the light is spread out along the long side of the room, the greater the amount of face light that the pupils have. Every pier introduced into the lighting area increases the number of pupils that will be affected by face light. The best lighted schoolroom from the standpoint of the pupils will be the schoolroom with banked windows properly located and with the required percentage of glass. From the standpoint of construction it is not necessary that there be any piers breaking up the group of windows. If any piers are introduced, there may be one with three windows on each side if the pier is reduced to a minimum, or there may be two with groups of two windows making six windows to a room, if the piers are merely small supporting piers. The Department of Public Instruction recommends as first choice banked windows, second choice one pier, third choice two piers. Very good reasons should exist if other than banked windows are used for lighting standard sized schoolrooms and classrooms.

Schoolrooms where pupils are seated must be arranged so that they will have either east or west light. South light gives excessive sunlight, causing curtains to be drawn most of the school day, and north light does not admit of sunlight for sanitary purposes.

The tops of the windows must not be lower than six inches from the ceiling and it is better if they extend to the ceiling. The sill should not be less than 2½ feet from the floor nor more than 3½ feet. If the windows are lower there may be danger from reflection of light from outdoors into the pupils' eyes and if higher the pupil will not be able to look out of doors to rest his eyes.

TRANSOMS

Windows should not have transoms as these bar the light across that part of the window where the best light for the room is available.

SKYLIGHTS

A room can be well lighted with skylights but they should not replace the unilateral lighting for the standard schoolrooms and classrooms. Skylights should be used sparingly. There are four main objections to overhead lighting:

1. It confines the pupils within the four walls so that they cannot see what is going on outside.
2. It often does not permit the direct rays of the sun to enter the schoolroom.
3. It is often too strong a light, or a light with streaks, either of which affects the eyes.
4. It is often retarded because the glass becomes covered with snow.

Overhead lighting is permissible for art rooms, shops, and library, and also for large assembly rooms and study rooms when it is not possible to light a room from one side.

REAR WINDOWS

Windows at the rear of the schoolroom are a detriment to the eyes of the teacher as well as causing the body of the pupil to cast a shadow over his work. If the light enters the schoolroom from more than one side there will be conflicting lights that will cause shiny places on walls, corners of the room, and blackboard.

CEILING HEIGHTS

The ceiling of schoolrooms should usually be a minimum of 12 feet. The width of the room should not be more than twice the distance from the floor to the top of the windows. Care should be taken not to have adjacent buildings and trees located near enough to the school building to interfere with the light. If there are courts they must be large enough not to interfere with the light. It is well also to have the walls of the school building on the court side of light construction so that there will be a good reflecting surface.

DECORATION

The walls and ceilings of the schoolrooms should receive careful attention because of the effect of the color upon the light of the room.

LIGHTING OF THE ASSEMBLY ROOM

The assembly room should be well provided with natural light for the hygienic effect of the sun's rays in the room. The windows should be provided with opaque shades so that the room may be darkened for moving pictures. Exits should have exit lights over them for use when the room is darkened.

FACTORY TYPE LIGHTING

Vocational and industrial arts school buildings may be lighted by northern saw-toothed skylights, and by arranging a series of columns for the construction and then filling in between with glass. Such buildings with so much glass should have diffused glass for east, south, and west sides to avoid the glare from the sun.

LIGHTING OF LIBRARY

The glass area for the library should equal at least twenty per cent of the floor space. All the light of the library can well come from above and the upper part of the room. This will leave a greater space for shelves for books.

LIGHTING OF GYMNASIUM

The gymnasium should be lighted with large windows that open outward so that they may be opened for the circulation of air. Skylights are not advisable for a gymnasium, for during certain portions of the year the room is likely to be too warm. The gymnasium may be lighted from more than one side.

LIGHTING OF HOME ECONOMICS AND MANUAL TRAINING ROOMS

The light for the domestic science room should be either unilateral or side and end light to give opportunity for cross ventilation and the glass should be equal to at least twenty per cent of the floor space. The glass area for the domestic art room should be equal at least to twenty to twenty-five per cent of the floor space. The light for this room should be unilateral and preferably located so that it comes from the north.

The light for the manual training room may be either unilateral or side and end if the placing of the furniture in the room is such that end lighting as well as side lighting is necessary to provide proper light for all manual training desks. The glass area for lighting the room should be equal to at least twenty per cent of the floor space.

The artificial light should be of proper amount and suitably located.

LIGHTING OF THE LABORATORIES

The light for the laboratories should be unilateral and the glass area should be equal to at least twenty per cent of the floor space. The lighting fixtures for these rooms should be placed where they will be of most value as well as giving general light for the room.

LIGHTING OF COMMERCIAL ROOMS

There is need for favorable light for the commercial rooms. The ruling, figuring, writing, and close work with the eyes require that the lighting of these rooms be as well planned as that of the other classrooms.

LIGHTING OF DRAWING ROOMS

The light for the drawing rooms should be unilateral to prevent confusion of shadows. The glass area must be equal to at least twenty per cent of the floor space. A room planned entirely for mechanical drawing might have the light from side and end to avoid the shadow from T square and triangle. The tops of the drawing desks are inclined and the nature of the work is such that pupils are not bothered by the reflection of light into the eyes. North light is preferable for drawing rooms.

LIGHTING OF STAIRWAYS

Stairways should be well lighted by both natural and artificial light. Every stairway must have an abundant amount of light for moral reasons as well as physical safety.

LIGHTING OF CORRIDORS

Corridors with rooms on each side should be lighted by both natural and artificial light. Corridors that have only end lighting should be further lighted by borrowed light from the rooms along the corridors. This borrowed light should come through diffused glass and the glass should be located well toward the ceiling of the room. The E and H shaped plans offer good opportunity for corridor lighting. Such construction, however, has the disadvantage of costing more because of the increased number of feet of outside wall needed for the same amount of schoolroom space.

The Illuminating Engineering Society code on natural lighting states that:

> "To secure the highest lighting value it is recommended that the room be so designed that no working location is more distant from a window than one and one-half times the height of the top of the window from the floor."
>
> "Window Openings. Tests of daylight in well lighted school buildings indicate that, in general, the glass area does not fall below 20 per cent of the floor area."

"Lighting Value of a Window. The lighting value of a window at any given location in the room, will depend upon the brightness of the sky, the amount of sky visible through the window at the given location in the room, and indirectly upon the reflection factor of the surroundings and the dimensions of the room."

ARTIFICIAL LIGHTING

There are three important kinds of artificial lighting: direct, indirect, and semi-direct. All of these have been installed in schools. The semi-direct is considered now as the best of the three for school purposes. The number of lights to be used will depend upon the floor area, size of the room, power of the light, surroundings, and the reflecting surfaces. The usual practice is to arrange for at least six ceiling lights equally distributed over the area of a classroom 22′ x 30′. Glossy surfaces should not be used, for a good reflecting surface may be secured from a dull finish. The artificial light should be arranged so that there is ample light for each pupil without leaving the control of the light to the pupil except where special kinds of work may require it. Stairways, basement, storeroom, and classrooms should have switches at the point of entrance.

In planning the artificial light for a school building care should be used to provide this light as near like the natural light as may be and without glare, shadows, or sharp contrasts. Too much consideration cannot be given to this phase of lighting by the superintendent, school board, and architect.

The following code prepared by the Illuminating Engineering Society should be followed in arranging for the artificial lighting of school buildings:

"Article I. General Requirements.—When in use, all buildings should be provided, during those hours when daylight is inadequate, with artificial light according to the following Articles:

Buildings hereafter constructed should be so designed that the daylight in the work space is reasonably uniform and the darkest part of any work space is adequately illuminated under normal exterior daylight conditions.

Article II. Intensity of Artificial Illumination.—The desirable illumination to be provided and the minimum to be maintained are given in the following table:

Desirable and Minimum Illumination

	Artificial Lighting Foot-candles (Lumens per square foot) At the work	
	Minimum	Ordinary practice
Storage spaces	0.25	0.5— 1.0
Stairways, corridors	0.5	1.0— 2.5
Gymnasiums	1.0	2.0— 5.0
Rough shop work	1.25	2.0— 4.0
Auditoriums, assembly rooms	1.5	2.5— 4.0
Classrooms, study rooms, libraries, laboratories, blackboards	3.0	3.5— 6.0
Fine shop work	3.5	4.0— 8.0
Sewing, drafting rooms	5.0	6.0—12.0

Article III. Shading of Lamps.—Lamps should be suitably shaded to minimize glare. Glare, either from lamps or from unduly bright reflecting surfaces, produces eye-strain.

Article IV. Distribution of Light on the Work.—Lamps should be so arranged as to secure a good distribution of light on the work, avoiding objectionable shadows and sharp contrasts of intensities.

Article V. Color and Finish of Interior.—Walls should have a moderate reflection factor; the preferred colors are light gray, light buff, dark cream, and light olive green. Ceilings and friezes should have a high reflection factor; the preferred colors are white and light cream. Walls, desk-tops, and other woodwork should have a dull finish.

Article VI. Switching and Controlling Apparatus.—Basements, stairways, storerooms, and other parts of the building where required, should have switches or controlling apparatus at point of entrance.

Article VII. Emergency Lighting.—Emergency lighting should be provided at main stairways and exits to insure reliable operation when, through accident or other cause, the regular lighting is extinguished.

Article VIII. Inspection and Maintenance.—All parts of the lighting system should be properly maintained to prevent deterioration due to dirt accumulation, burned-out lamps and other causes. To insure proper maintenance, frequent inspection should be made at regular intervals."

The code further states that

"Except in very rare instances bare light sources should not be exposed to view. They should always be adequately shaded or completely hidden. Even when shaded by translucent media, such as dense glassware, the lighting units should be placed well out of the ordinary range of vision; in other words it is recommended that lighting units be of low brightness, even if they are located high in the field of view.

The maximum brightness contrast of juxtaposed surfaces in the normal visual field should be preferably not greater than 20 to 1; that is to say, the darkest part of the work space observed should have a brightness preferably not less than one-twentieth of that of the brightest part."

"Design of Lighting Installation.—The illumination on the horizontal work plane should be as uniform as possible. The variation should not be greater than 4 to 1."

"The chief factors which must be considered in arriving at the size and number of lamps to be used in a given room are (1) the floor area; (2) the total luminous flux emitted per lamp, and (3) coefficient of utilization of the particular system considered. The first should be measured in square feet. The second may be obtained from a data book supplied by the manufacturers of lamps. The third involves many factors such as the relative dimensions of the room, the reflection factor of the surroundings, the number of lighting units and their mounting height, and the system of lighting. By coefficient of utilization is meant the proportion of the total light flux emitted by the lamps which is effective on the work plane. In the accompanying table approximate coefficients of utilization for modern lighting equipment are given. The work plane in this case is a horizontal plane 30 in. (76 cm.) above the floor. These values refer to the initial installation without any allowance for depreciation."

WINDOW SHADES

The window shades should be selected with much care if the natural light is to be best controlled. Light colored shades that are translucent should be used. There are now on the market several different makes of adjustable translucent shades which are giving good satisfaction. Superintendents of schools usually know where such curtains may be purchased. The Department of Public Instruction wishes to emphasize the importance of the window shades and urge school boards and

superintendents to provide them for their school buildings. It is the business of the teacher to see that they are properly adjusted.

The Illuminating Engineering Society in their code for lighting schoolhouses have the following to say regarding window shades:

> "Window Shades.—Although direct sunlight is desirable in interiors from a hygienic standpoint, it is often necessary to exclude or diffuse it by means of shades. These shades should perform several functions, namely, the diffusion of direct sunlight, the control of illumination to secure reasonable uniformity, the elimination of glare from the visible sky and the elimination of glare from the blackboards wherever possible. These requirements make it desirable to equip each window, especially in classrooms, with two shades operated by double rollers placed near the level of the meeting rail. The window shades may thus be raised or lowered from the middle, which provides the maximum elasticity for shading and diffusing the light. The shades should be preferably of yellow-colored material that is sufficiently translucent to transmit a considerable percentage of the light while at the same time diffusing it."

STEEL SASH

Additional radiation must be allowed if steel sash is used because of the increased heat conducting surface. These windows may be cheaper to install so far as the cost of the window is concerned, but they are likely to be more expensive if the extra cost for radiation and fuel is considered.

HEATING AND VENTILATION

GENERAL REQUIREMENTS

The heating and ventilating of schoolhouses has of late years been given considerable attention. Many schemes have been tried out by those who were not qualified to lay out a complicated system of ventilation. A competent heating and ventilating engineer should be employed to lay out all large heating and ventilating systems for school buildings, for it is not possible to write directions which the layman can use as a guide in installing such a system. The proper conditions for the health of the children should cause school boards to give very serious consideration to this phase of schoolhouse construction. Any system that is installed should be as simple as efficiency will permit because there is danger that any complicated system will not be properly operated.

The ventilating apparatus installed by the contractor or heating engineer should be of such capacity that the air will not leave the spray chamber without being properly tempered, humidified, and cleaned in localities in which the air contains smoke, dust, or other objectionable irritants. Water heaters of an approved type should be installed to heat the spray water. The contractor or heating engineer should install such humidistats, thermostats, diaphragm valves, and other equipment as may be necessary for the proper control of temperatures, the spray water tempering, and the humidifying of the air.

In the installation of a heating system, the rules adopted by the Heating and Ventilating Society should be followed.

The best air, no doubt, is that which exists out of doors on a sunshiny spring day after a thunder shower. To make the air of the schoolroom as near to this ideal as possible is the purpose of ventilation. Ventilation is concerned in removing the heat from the body and the supplying of air to the lungs in proper condition. It is concerned, therefore, with the following factors:

1. Sufficient air, properly distributed
2. Proper temperature of the air
3. Sufficient air motion
4. Reduction and elimination of odors and impurities
5. Sufficient humidity
6. Removal of bacteria and dust

Sufficient air does not necessarily mean good ventilation. The air must be distributed. The windows of the schoolroom may be opened but this does not necessarily mean good ventilation, for parts of the room may have an over abundance of air while other parts will have an insufficient

amount. The air introduced should not be rapid enough to cause disagreeable drafts, but it must be sufficient to remove the heat from the body at a rate that will be desirable for health and comfort. Good ventilation means that there is no envelope of air formed about the body which may increase the temperature and moisture contents of the body to the extent that the evaporation from the skin is retarded. The air introduced should be sufficient to neutralize the objectionable odors given off from the skin, clothing, lungs, and throat.

Air is a definite medium. If air is to be introduced into the room some provision must be made to get this air from the room. Ventilation then concerns itself not only with the air to be brought into the room but with the air to be carried out. The end to be sought in ventilation is hygienic, economic, and mechanical. Of these, the hygienic is the most important. Air in nature is purified by sunlight and other agencies, but in the schoolroom we are also dependent for purification of air upon removing the air from the various schoolrooms and replacing it by other air. It is the business of those responsible for the installation of heating and ventilating systems to see that the child has air as nearly as possible like the clean washed air which is found out of doors away from the contamination of factory, industrial, railway, and congested districts.

GRAVITY SYSTEM

The best system of ventilation is a mechanical system of sufficient capacity to care for the six factors mentioned above. A gravity system is not reliable and should not, therefore, be installed, except in small buildings where the operation of a mechanical system would be impracticable from the standpoint of administration.

The gravity system depends largely on the difference in temperature between inside and outside air. The colder the air outside the more rapid the flow of the air in the room. Long horizontal ducts and ducts of unequal heights affect the flow of air. On a still day the flow of air may be perfectly balanced while on a windy day there may not be sufficient heat on one side of the building, or there may be such a quantity of cold air flowing into the ducts that it cannot be raised to the proper temperature before reaching the schoolroom. A gravity system is of no value as a ventilating system in warm weather. Gravity vent flues must extend from the floor line without bends to the ventilators in the roof. They must never terminate in the attic.

DIRECT HEATING

Direct heating does not contemplate ventilation. It is such heating as that of stoves and radiators. In most heating and ventilating systems

some direct heating is used to raise the air of the room to the required temperature. The air brought into the room is heated by a different heating unit.

INDIRECT HEATING

The indirect system when no fan is used contemplates a furnace or steam coils located in the basement where air will pass over heated surfaces. If the air is admitted from outside there will be a certain measure of ventilation. In this system of heating and ventilating the air is usually passing over highly heated surfaces with the result that when it reaches the schoolroom it is very deficient in the percentage of humidity it should carry for the health of the pupils. The introduction of water pans or steam jets will help to restore the humidity, but usually not sufficiently.

FURNACES

A furnace plant for heating and ventilating is usually cheaper to install and more simple to operate. There is, however, liability of dust, smoke. and gases from cracked furnaces and leaky flues as well as a difficulty in the equal distribution of heat unless a fan is used. Such ventilating systems often have a low relative humidity because there is not installed sufficient humidifying apparatus.

STEAM HEATING SYSTEM

Most of our larger school buildings are heated through direct radiation by means of steam. The steam heating system has the advantage of placing the heating units at that part of the room from which the heat distribution can be best controlled. A steam system should be installed so that there will be proper drainage from the radiators, and so that there will not be a pounding of the radiators in the schoolroom. The best system for schoolrooms is the two pipe gravity system or the vacuum return system. So far as the heating of the building is concerned the steam system when properly installed gives good results.

FORCED VENTILATION

In order to have a positive system of ventilation, there must be a mechanical system to force air into the various rooms of the building. There art two general systems of forced ventilation; the exhaust system and the plenum or pressure system.

EXHAUST SYSTEM

The exhaust system is little used now except for toilet rooms, kitchens, lunch rooms, swimming tanks, domestc science rooms, and other rooms

from which disagreeable odors may be disseminated to the discomfort of the occupants of other rooms. Ventilators for such rooms must be connected directly to stacks so that there can be no opportunity for re-circulation of the vitiated air throughout the building.

FAN SYSTEM

The fan system may be designed to furnish both heat and ventilation or it may be used only to provide ventilation, the heating being done by direct radiation. If ventilation only is supplied the air passes through tempering coils, the air washer, and the fan which forces it through heating coils into the hot air chamber, and if necessary into the tempering chamber. The mixing damper which is controlled by thermostats from each room adjusts itself to allow air of the right temperature to enter the room. The temperature of the tempered air is maintained at 68-70 degrees.

There are fan systems that do nothing more than distribute the air to the rooms. In such systems no provision is made for the washing or humidifying of the air. Such systems have nothing to commend them over a simple gravity system, except that there is a better distribution of air.

Provision is made with the fan system as well as with other ventilating systems to remove the air from the room through the means of vent ducts which have an opening into them at the floor line. These ducts either empty into the attic from which the air passes out through ventilators on the roof or they connect directly with the ventilators either separately or by uniting in the attic into one or more pipes which connect with the ventilators. The usual practice, however, is to empty the air into the attic, using it as a re-circulating chamber by means of roof ventilator dampers which can be controlled from the furnace room.

The fresh air from out of doors is emptied into the room on the same side of the room as that on which the vent ducts are located either just below the ceiling or it is carried across the ceiling between the joists in galvanized iron ducts and distributed into the room from several places in the ceiling, usually six in the standard size schoolroom. If the air is delivered to the room through one opening, diffusers must be installed to distribute the air properly. Except where designs may particularly require it grilles and registers in vent ducts and heat ducts should be omitted.

WINDOW VENTILATION

Window ventilation should not supplant forced ventilation, for the placing of sufficient direct radiation to overcome heat losses when window ventilation is used often results in over-heated schoolrooms. Good light-

ing requires that schoolrooms have unilateral lighting. This means that there can be no cross ventilation. On windy days there may be too much air or more likely an unequal distribution of air. With one side lighting there may actually be air moving out of the rooms rather than into the rooms with windows open, for on the leeward side there is a zone of negative pressure.

If a mechanical heating and ventilating plant is properly designed there can be little harm from the opening of windows; neither is there much value for the outside air would need to be under a pressure that would overcome the pressure of the fan. The present systems of ventilation were designed because window ventilation proved inadequate. It would seem, therefore, that the best ventilation is to be securd by the improvement of our present methods. School boards and superintendents need to investigate very thoroughly the reliability of those who may be advocating radical changes from that which is at the present time followed by our best heating and ventilating engineers. We are often ready to accept the statement of some medical man, some psychologist or some faddist relative to the subject of school ventilation when as a matter of fact the statement is not based upon careful scientific study and experimental investigation.

AIR DUCTS AND FLUES

Much care should be given to the construction of air ducts and flues for any system of heating and ventilation. The ducts or flues may be galvanized iron, tile, cement, or brick, but the inside of the duct or flue over which the air passes to or from the room must be perfectly smooth. The velocity and movement of air is retarded by uneven surfaces. Sharp turns should be avoided. The ducts or flues should not be constructed so that high velocities will be required. In no case should air be delivered into the room at a velocity that will cause visible drafts. Every duct or flue that brings air into the room of school buildings of more than one room should have a damper to control the supply. There should also be tempering dampers to regulate the temperature of the air supply.

FRESH AIR

The fresh air should be brought into the school building not lower than the top of the first story. The intake should have louvers to keep out rain and snow. There should be provision for re-circulating the air for economy and quicker heating when heating the building in the morning. A good fan should be installed to distribute the air and the motors installed should have relatively slow speed to insure quiet running and durability. If the school building is located where the air may be laden with physical impurities, air washers should be installed.

The fresh air dampers should be arranged so that they work in conjunction with the re-circulating dampers and ventilators. The installation should be simple so that the turning of a pneumatic switch will cause the fan to handle either fresh air or re-circulated air. The operation of the dampers controlling the air intake and the dampers in the room ventilators should be such that when the air pressure is on the diaphragm motors in the attic, the roof ventilators and the fresh air intake will be open and the re-circulating dampers closed, allowing fresh air to be taken in by the fan.

FAN CONNECTIONS

There should be sheet metal connections from fresh air shafts to tempering coils, from tempering coils to air washers, from air washers to re-heater coils, from re-heater coils to the fan, and from the fan to the air intake. The connections should be made of a substantial weight of galvanized iron, thoroughly braced. The connection to the fan inlets should be by means of canvas so as not to convey the vibration and sound of the fan throughout the building.

VOLUME DAMPERS

Suitable volume dampers should be installed at the base of all risers, or at some other proper place to adjust the flow of air into the various schoolrooms. These should be adjustable and arranged so that they can be set and fixed in position. These dampers should be provided with an approved damper adjustment device and all adjusters should be securely fastened on ducts and on dampers. The exhaust ducts should also have adjustable dampers that can be set and securely locked in place.

AIR FILTERS

Air filters composed of coarse cloth for the removal of dust are not satisfactory, for they soon become clogged and do not allow the free passage of air to the schoolroom.

AIR WASHERS

Dust is objectionable. It carries disease germs and acts as an irritant on the delicate membranes of the body. Instead of the use of air filters to remove dust particles, air washers are now generally used. The usual air washer consists of spray nozzles, scrubber plates, and eliminator plates. The spray nozzles are banked across the path of the air and the water forced through them in the direction of the air flow. The air is drawn through this spray by the fan. Much of the dust and other impurities are thereby removed. The scrubber plates change the direction of the flow of the air so that the dirt will be thrown out by its own inertia

and the passing over wet surfaces. The plates are kept flooded by sprays or nozzles placed above them. The air then passes to the eliminator plates where the excess water is removed. The water from the washer falls to the lower part of the washer where it is removed by means of a circulating pump. Provision should also be made for the removal of the dirt so that it will not interfere with the circulating pump. Water needed for the washer is admitted through a float valve. The air washer is placed between the tempering coils and the heating coils of the fan system so that the water entering the washer will not be so cold that the spray water will be frozen. The air washer not only cleanses the air but it also serves to place the air at the proper humidity. Sufficient heat and moisture are added to the air to leave the washer at a temperature and saturation for proper humidity. The air is then passed to the heating coils where the temperature is raised without affecting the moisture content. The water in the tank of the air washer should be protected against freezing when the fan is drawing the air.

HUMIDIFYING OF AIR

Those who have given considerable study to the ventilating of school buildings are uniformly of the opinion that the humidifying of the air is very important but not easy to solve. Air passed over heated surfaces has a greater carrying capacity for moisture and if this moisture is not supplied it will be taken from available sources such as the nose, throat, and eyes of the occupants of the schoolroom. This will cause inflammation of the membranes of these organs and subject the person to colds and diseases. Low humidity increases the evaporation from the skin so that a person does not feel so warm as he would if the relative humidity were high and the temperature lower. No system of heating and ventilation should be installed without ample provision for keeping the relative humidity at a proper level. Hot air furnaces which are provided with water pans should have the pans placed next to the heated surface of the furnace in the path of the air. These pans should have a large evaporating surface and provision should be made for keeping them automatically filled. It should be kept in mind that the amount of moisture that should be available is dependent upon the temperature of the air and the amount that passes through the heated chambers of the furnace to the schoolroom.

If the air that is carried to the schoolroom is warmed by means of pin radiation, there must be provision made to give this air the proper humidity before it enters the schoolroom.

TEMPERATURE CONTROL

The boilers, radiators, and other parts of the heating plant are designed for heating the building at the lowest temperature outside. The usual weather conditions are not, however, nearly so low as that represented by the lowest outside temperature. It is very important, therefore, that there be some means of thermostatic temperature control so that during the milder weather there will not be excessive heat. This control should be automatic to promote the health and comfort of the pupils as well as to save fuel, for individual control is not desirable or satisfactory. It leaves too much to the judgment and individual attention of teachers.

The persons installing air tempering and humidifying equipment should be required to guarantee that all defects will be taken care of for a period of at least one year and that it will give the results called for in the plans and specifications as to the washing, tempering, and humidifying of the air handled by the fan. The equipment should be noiseless and require only a minimum amount of attention.

ROOF VENTILATORS

Roof ventilators of an approved type with a capacity sufficient to carry off the vitiated air that is emptied into the attic must be provided. If the ventilator is to be attached directly to the ventilating pipe then it must have the capacity of that pipe. In a gravity system the vent ducts must be continuous through the attic to the ventilators, or brick stacks must pass through the attic and above the highest point of the roof at a height similar to smoke chimneys. Vent stacks in a gravity system must be provided with some means of heat such as aspirating coils.

All roof ventilators in which forced ventilation is used should be provided with dampers and diaphragm motors which operate in conjunction with the intake and re-circulating dampers.

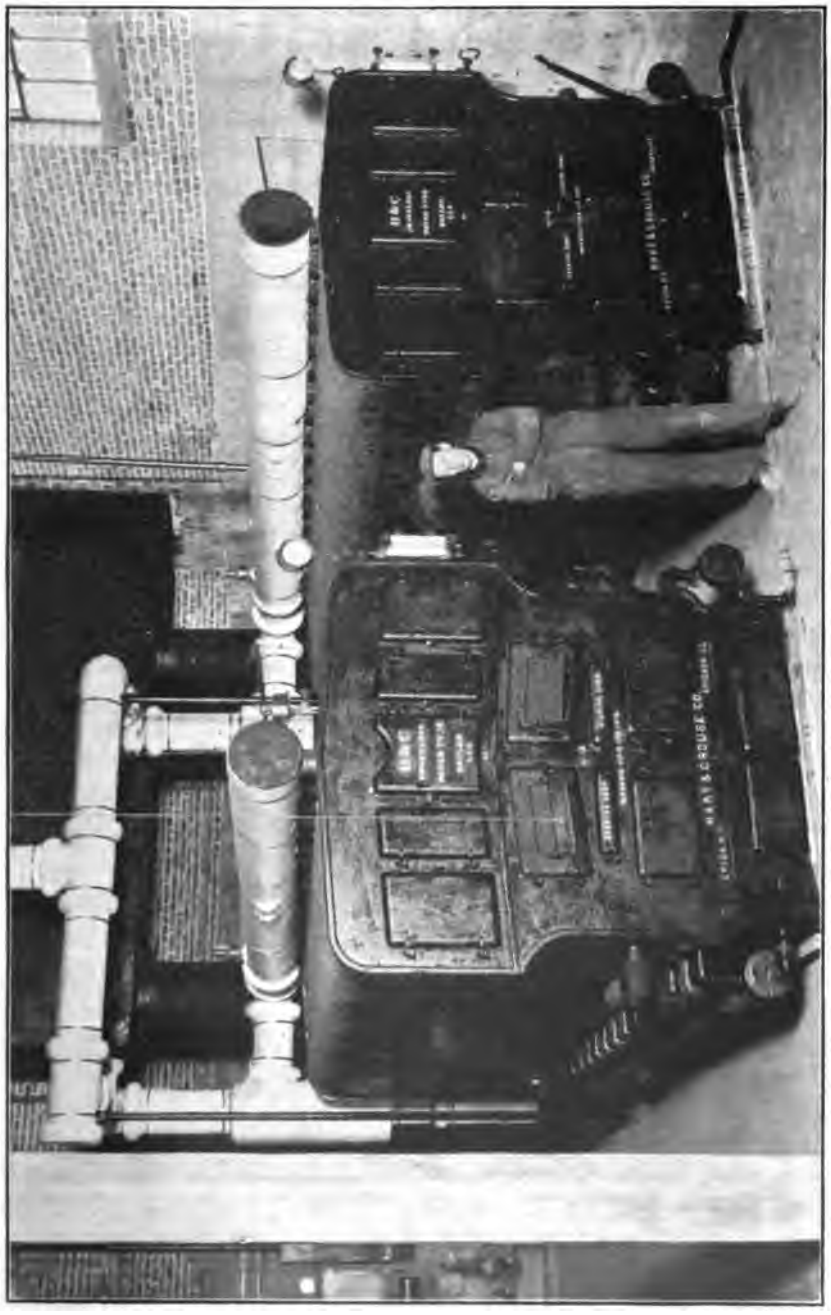
SHEET METAL WORK

All ducts and connections that are made of galvanized iron should be properly stiffened and supported and constructed in a neat, workmanlike manner and only first class material should be permitted to be used. All longitudinal joints should be lock seamed and all end joints of pipes large enough to give trouble from bulging or sagging should be properly stiffened. All horizontal ducts should be securely hung in position.

VENTILATION INDICATORS

There should be installed in the principal's or superintendent's office indicators with a face marked with fresh air and re-circulated air and so

connected with the apparatus controlling the fresh air and re-circulated air that the dial in his office will register whether fresh air or re-circulated air is being used in the building. The principal or superintendent should be in a position to know whether the janitor is operating the ventilating apparatus without leaving his office. His many duties will not permit his making a trip several times each day to the basement and to the attic for the purpose of supervising this important part of school administration.



A Boiler Installation, Henry R. Pattengill Junior High School, Lansing, Michigan

GYMNASIUM

PURPOSE

Every modern school building should be equipped with a gymnasium and some place for a general assembly of the pupils and the patrons of the district. The cost is always a factor in determining whether a gymnasium will be constructed. There may be a separate gymnasium, a separate auditorium, and a separate study hall or a combination of study hall and auditorium or a combination of gymnasium and auditorium. The arrangement for separate gymnasium, auditorium, and study room is better if the district can afford it and there is a real need for the auditorium. If they cannot afford this it is better to have the gymnasium and auditorium combined in purpose because this eliminates the disturbing of pupils' property left in the general assembly room or study room, which may be used for auditorium purposes.

The gymnasium has as much right in the building as any classroom that the district builds aside from those used for grade purposes. There is not much foundation for the statement that the child will get exercise without providing a place for it at the expense of the taxpayers. The exercise that he gets may be harmful. It is a good idea, perhaps, to require the child to hoe in the garden, saw wood, or perform other duties about the home or farm, but this exercise alone may cause stooped shoulders, lessened lung capacity, or other deformity unless there is an opportunity for corrective exercises in a gymnasium under the direction of a teacher who knows how to develop the body of the child in harmony with the activities which he should perform at home and on the playground as a part of his training for good health and citizenship.

SIZE

The minimum size of a gymnasium is 35-42 feet by 50-60 feet and 18 feet in the clear in height. This size should not be constructed unless funds are not available for a larger one. Such a gymnasium provides no place for the public when competitive games are played. The best size for gymnasiums is from 50 to 60 feet wide by 70 to 90 feet long, and at least 22 feet in the clear in height. A gymnasium of this size is ample for all games that may be played in it as well as giving space at sides and ends for those who wish to watch the games. It is a fatal mistake to construct a gymnasium that does not have room for spectators during competitive games. A school needs the community support which comes from such exercises. Balcony space for spectators should be provided when the gymnasium serves as a combination auditorium and gymnasium.

An ample sized gymnasium provides a larger space for auditorium purposes when the gymnasium is used as a combination gymnasium and auditorium.

LOCATION AND ARRANGEMENT

The gymnasium should be located on the ground floor and where it is easily accessible to other parts of the school building and to the public. It should have a storeroom adjacent for storing chairs and other material used in the gymnasium. It must have separate dressing rooms and shower and locker rooms for boys and for girls. These rooms should be located so that those using the gymnasium may go directly to them without going into or across the general corridors of the school building or up and down stairs.

If the school is large there should be two gymnasiums, one for boys and one for girls, for in a large school the instructional work will be carried on throughout the school day with various groups of boys and girls. These gymnasiums may be constructed so that they may be converted into one larger gymnasium for competitive games. This arrangement is especially valuable because it provides seating space for the public interested in competitive games.

If the gymnasium is to be used for auditorium purposes it should be provided with an ample stage at one end. The space used for the stage may be used for seating purposes when the public is present at games.

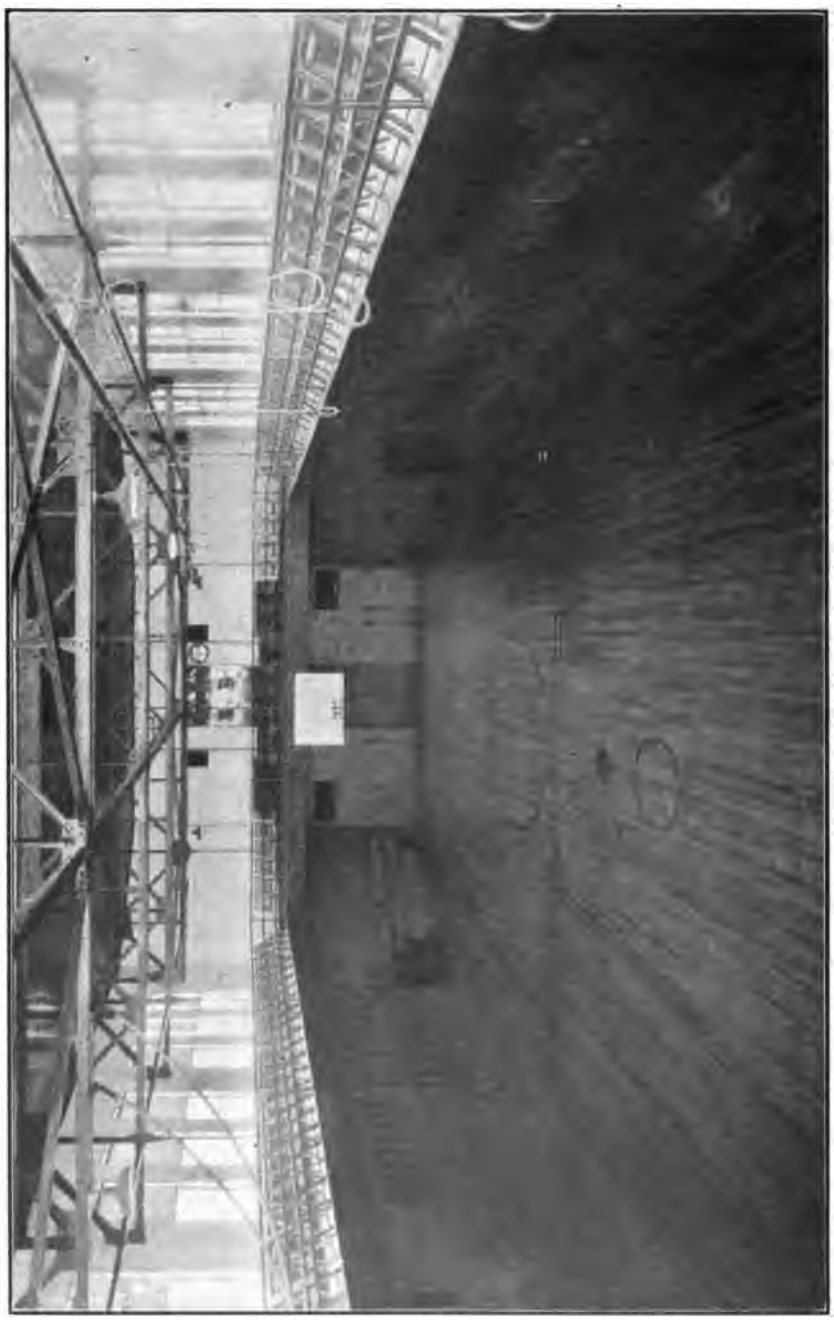
The floor of the gymnasium should be the very best. The most satisfactory floor is hard maple dressed perfectly smooth. The floor should be marked for basket ball and indoor ball.

HEATING AND VENTILATION

Every heating and ventilating apparatus should have provision for shutting off the heating and ventilating system from the gymnasium and auditorium when that part of the building is not in use. The radiators is used for heating purposes should be screened in the wall and screened flush with the wall. The fresh air may enter the room near the ceiling, at the ceiling, or at some other convenient place where there will be a proper distribution of air. Usually the openings to the vent ducts are located below the stage if there is a stage, or if not, the same general rule is followed for their location as if they were to be located in a classroom.

LIGHTING

The gymnasium should have ample light. Windows that open outward are best for the circulation of air. Skylights are not desirable for lighting purposes, for during the warm days the sun on the skylights makes the room too warm.



Gymnasium, Muskegon Heights, Michigan

TRACK

Very few school districts of this state will find it necessary or desirable to provide for an indoor track, for in most instances the track will be of more value on the playfield where the student may get his training in the open air.

DRESSING ROOMS, SHOWERS, AND LOCKERS

The boys should have preferably side showers, simple to operate, and arranged so that a group of boys can quickly pass through the showers of different temperature. Individual side showers should be provided for girls. There should be a minimum of six showers for the girls with twelve booths. If two girls will dress in one booth this arrangement will provide for a class of twenty-four girls. If only one girl will dress in a booth there will need to be one shower for each two girls in the largest class or group that will use the showers at any one time. The partitions surrounding the showers should be non-absorbent and canvas curtains should be provided for the doorways.

The number of showers to be installed for each of the boys and girls will depend therefore upon the number to be accommodated at any one time.

The locker arrangement depends upon the available space and the number of pupils who are doing the physical training work. A basket system may be used whereby the basket that holds the personal equipment is filed by number. The pupil gets his basket and carries it to the dressing room. He deposits his street clothes in it during his physical training class period. Aisles three or four feet wide should be provided between the lockers.

THE SWIMMING POOL

Here as with the gymnasium there is the call for sunlight and cleanliness. If possible, the natatorium, or room in which the swimming pool is located, should be located outside the rest of the building with a skylight roof, or if it must be under another floor, it should be placed on the sunny side of the building. One of the most gratifying developments in gymnasium construction is the large percentage of sunlit swimming pools. Many buildings may be arranged with a large central light court which, though the natatorium be in the basement, allows a large skylight area over a good portion of the pool.

In point of location, proximity to all bath rooms is essential. Except for spectators, there should be no way to get into the natatorium other than through a shower room. A thorough bath should precede every swim. There should be no baths in the natatorium.

A Locker Arrangement

The size of the pool proper is practically standardized at 60 feet long by 20 feet to 30 feet wide. A larger pool is sometimes advisable, while a pool less than 40 feet long is too short for practical results. The natatorium should be not less than 12 feet longer and 10 feet wider than the pool. A clear floor space of 15 feet between the deep (or spring board) end of the pool and the wall at that end of the room with a uniform floor space 10 feet wide around the other three sides closely approximates the ideal. In case spectators are to be accommodated on the level with the pool there should be much more space. It is essential to have a low railing as a dividing line between the space for those using the pool and the spectators. If possible space for spectators should be arranged as in a theater so that all the spectators can see all of the pool. The growing popularity of aquatics is indicated by the increasing number of swimming pools having commodious spectators' galleries.

The ceiling (or beam) height should be not less than 12 feet. A ceiling high enough to accommodate a spectators' gallery is advisable. The day of the odoriferous pool in a dark, damp room with an oppressively low ceiling is past.

The natatorium requirements for white tile floors, walls, and ceiling are the same as those for the shower bath room previously described. Here again, the floor tile must be of the non-slip finish. Floor radiators should be recessed into, and flush with walls, with all such wall openings carefully screened. If exposed radiators cannot be avoided, they should be located on the walls (not less than 6 feet above the floor), or on the ceiling. Exposed steam risers should be carefully covered to a height of 6 feet above the floor. All projecting corners should be given a generous round.

The floor around the pool should have only sufficient pitch to carry off the water which would otherwise accumulate. The direction of drainage is preferably toward the walls (away from the pool) to a narrow drain trough or gutter. If possible, there should be no elevated curb around the pool.

The necessity for unusually heavy water-proofed concrete construction for the pool bottom and walls is generally well understood. An open space or tunnel all around the outside of the walls of the pool will prove valuable for various reasons. The pool should be lined with white tile or glazed brick. Around the walls and slightly above water level, there should be a recessed scum or drain trough, molded into the heavy porcelain tile section especially constructed for this purpose. (See page 77.) The bottom of this drain trough should have frequent (screened) connections with a good-sized drain pipe connecting with the sewerage system. This trough should also be deep enough to prevent the contents of it from being washed back into the pool.

The deepest point of the pool should be from 2 to 3 times the distance of the spring board overhang—in from the wall at the deep end, which, in a 60 foot pool usually amounts to from 12 to 15 feet with the average closer to 12 feet. (See page 77.) The shorter the pool, the farther back the board may be set with a correspondingly shorter distance between the deep point and the wall at the end. The depth of water usually averages from 3 feet 6 inches or 4 feet at the shallow end to 8 feet at the deepest point with a depth of about 6 feet at the deep end wall.

Direction and warning lines (See page 77) formed by black tile or other good contrasting color, six inches in width and so placed that the swimmer swims above the lines, should run lengthwise of the bottom of the pool. These lines should continue from the bottom of the tank and extend six or eight inches above the surface of the water. They tend to make the swimmer swim straight while engaged in competitive swimming. Along the side margins of the pool, there should be distinct depth readings in different colored tile, every five feet. For competitive swimming purposes it is convenient to mark the sides of the pool just above the water in yards or feet, beginning at the deep end.

In each corner of the pool should be placed a series of recessed openings in especially formed tile that bathers may have an easy means of leaving the water. These recessed steps should be black so as to be easily discernible. Some authorities insist on having another set of recessed steps at the middle of the sides of pool. This is an excellent idea, especially where the pool is a large one. These recessed steps should also be black for convenience in locating.

The length of the standard spring board for pools in general is 10 feet 6 inches. (See page 77.) Strong floor attachment is effected by means of especially constructed anchors, set flush with the top of the finished floor. The board is bolted to the anchors with heavy brass machine bolts, by the removal of which the board may be easily taken away for special occasions. All exposed metal parts of the board are brass. Any exposed iron fittings will rust and stain the pool. The spring board anchors require a floor thickness of 8 inches. They should always be secured in advance and carefully set according to plan, when the floor is poured.

An overhead swimming instruction cable, or track, with trolleys for suspended belts to support beginners, is a valuable piece of equipment. The swimming instructor cable should run along parallel with one side of the pool, not less than four feet from it, nor more than six feet. The cable should be at least eight feet above the water level, and ten or twelve feet is still better.

Another recent development is the so-called shepherd's crook—a very effective life-saving device—surer than throwing a life preserver. It

consists of a long, light pole, to one end of which is fitted a hook large enough to go around the body. The length of the pole (usually 14 feet) should be a little longer than half the width of the pool. If the pool is not accessible from both sides, a jointed or extension pole is necessary.

The installation of a trapeze or rings over the water is not advisable. The circumstances under which they are used involve too great an element of danger. A fountain cuspidor should be recessed into one or both end walls of the natatorium.

Architects have at hand or can secure the information necessary to handle properly such technical matters as hot water supply, heaters, filters, sterilization, etc. The demand for clean, transparent water is so general that the use of filtered water should not be questioned. A filtration or refiltration system is recommended as part of standard equipment. In the long run it is usually an economy. At all hazards, swimming pool water should be clean and safe at all times. In this day and age it is criminal negligence to allow the water to become insanitary and bacteria-laden. Any institution which does not keep its swimming pool clean should be closed and investigated by the Board of Health as a probable source of disease and infection. Unless an adequate system for refiltration of the pool water is installed, *and effectively operated,* swimming pool water should be changed once a week. In case the filtration system fails to function, the following treatment will keep the water safe and free from a dangerous percentage of bacteria: One pound of chloride of lime (one-third available) to every forty thousand gallons. (five thousand cubic feet) or one-quarter pound to each average foot of depth in a 25 foot by 60 foot pool. The less sunshine reaching the pool. the higher will be the percentage of bacteria. There can be no excuse for an insanitary swimming pool at the present time. There are many instances on record where the water in pools after several weeks' use has been found to give a better test than when admitted from the city mains.

In some pools of earlier construction the reflection of sound from the walls has been most annoying. This trouble can be almost, if not entirely, done away with by the proper treatment of the walls and ceiling with trade preparations of various kinds which deaden the sound and do away with the reflection. This feature of construction is an important one, as the noise in pools makes it very difficult for instructors and life guards to attend properly to their regular duties.

Where the pool is to be used by groups of children, some of whom can swim while others cannot, it is well to divide the pool by means of a stout net. This net should be placed about twenty feet from the shallow end of the pool and should extend from the surface of the water to the bottom of the pool. The group of non-swimmers cannot then forget themselves

and get beyond their depth. At the same time the swimmers will not be encroaching on the space of the non-swimmers. The net can be secured by means of four brass or well galvanized screw eyes properly placed. These eyes can be placed after the completion of the pool by means of expansion bolts.

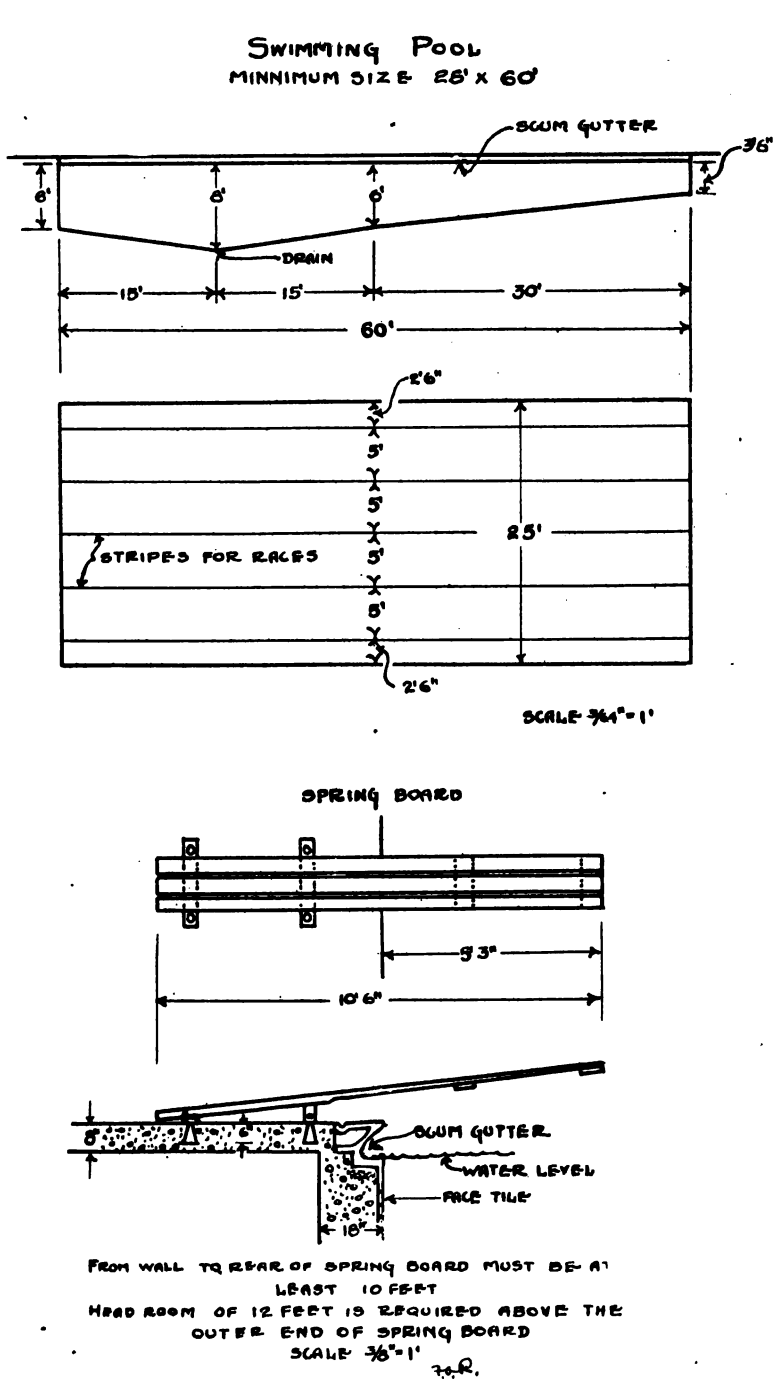
The only consideration of the subject of toilet rooms here necessary is to urge that a sufficient number be supplied. There should be an adequate toilet room closely connected with each separate locker and bath room. A general toilet (one for each sex) will be found necessary for most gymnasium buildings.

DIRECTOR'S ROOM

The gymnasium should have adjacent to it an office for the director. If there are both a man and a woman director, it is well to provide for a small office for each, where files, correspondence, and material may be kept, and where the director may hold consultations with the students. It is well to have an inner office where there can be an examining room, washbowl, toilet, and first aid material. In the inner office of the woman director there may be rest chairs and couch. The office should be located so that the director may easily supervise the pupils during their physical training activities.

EQUIPMENT

A competent and experienced teacher should be consulted before purchasing equipment for the gymnasium. The State Director of Physical Education of the Department of Public Instruction at Lansing, Michigan, will upon request meet with school authorities to advise with them concerning the gymnasium equipment and the layout of playgrounds and their equipment.

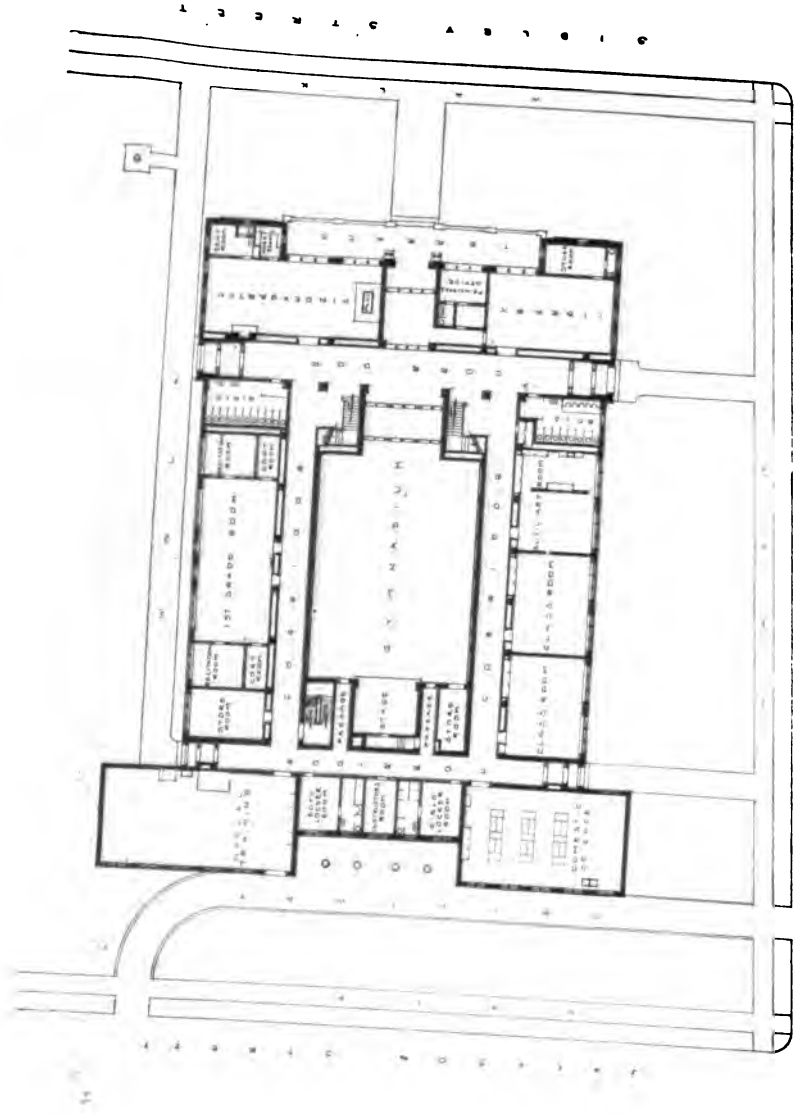


A Sketch of a Swimming Pool

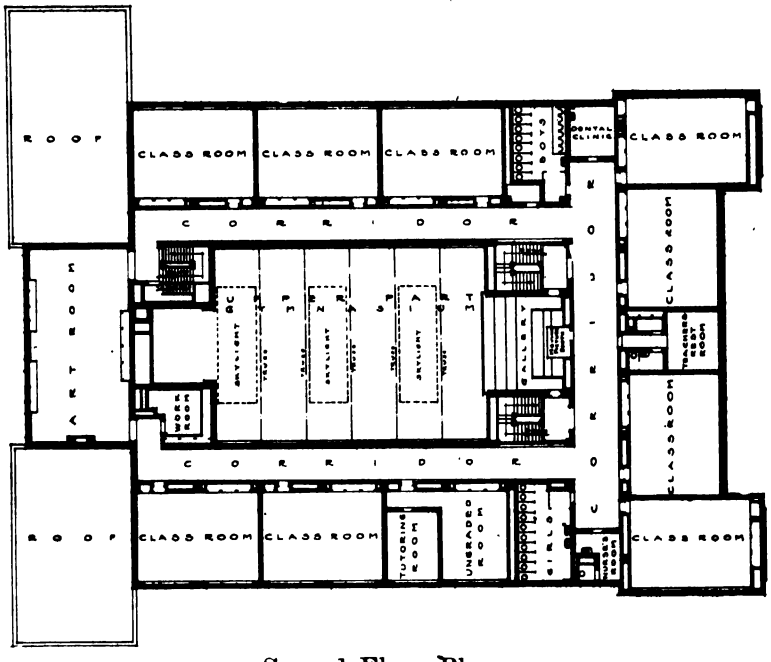
SCHOOL BUILDINGS CONSTRUCTED IN MICHIGAN

The plans of school buildings which have been included are not given with the idea that they represent the ideal in every particular. They are given as an illustration of some of the good school buildings that have been constructed in this state in the past few years.

Sibley School, Grand Rapids

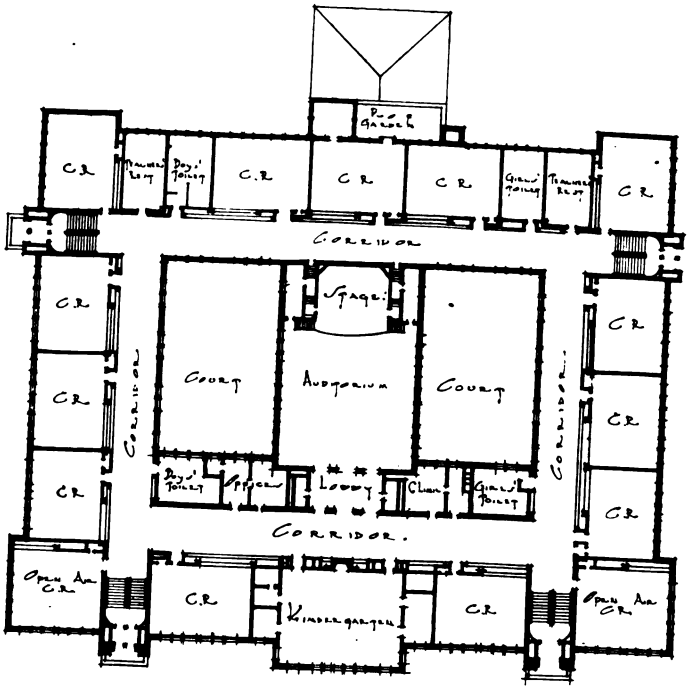


First Floor Plan

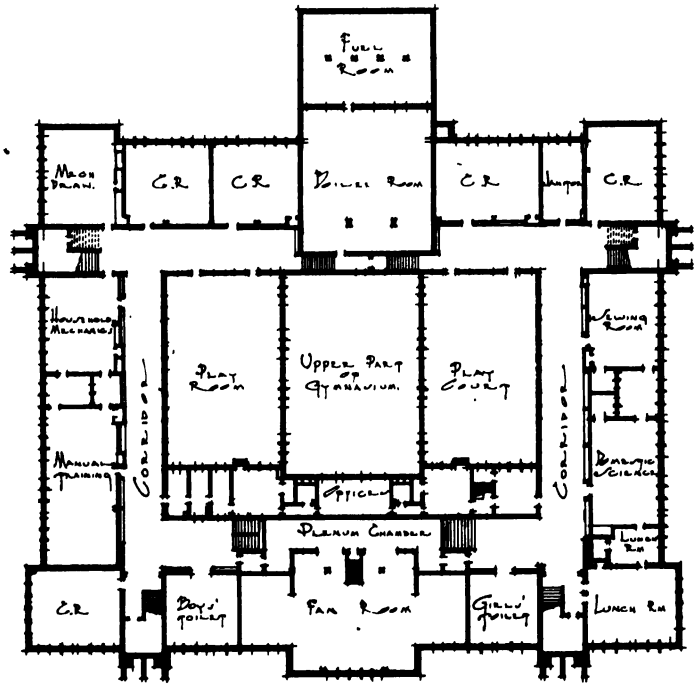


Second Floor Plan

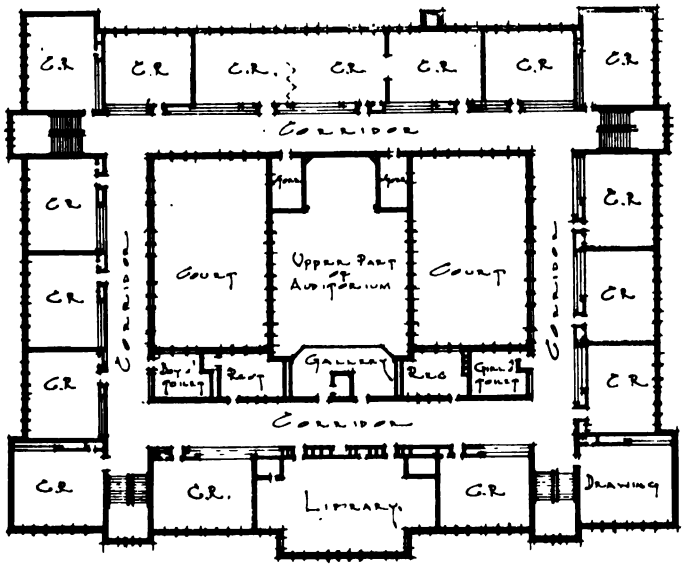
Grade School, Detroit



First Floor Plan

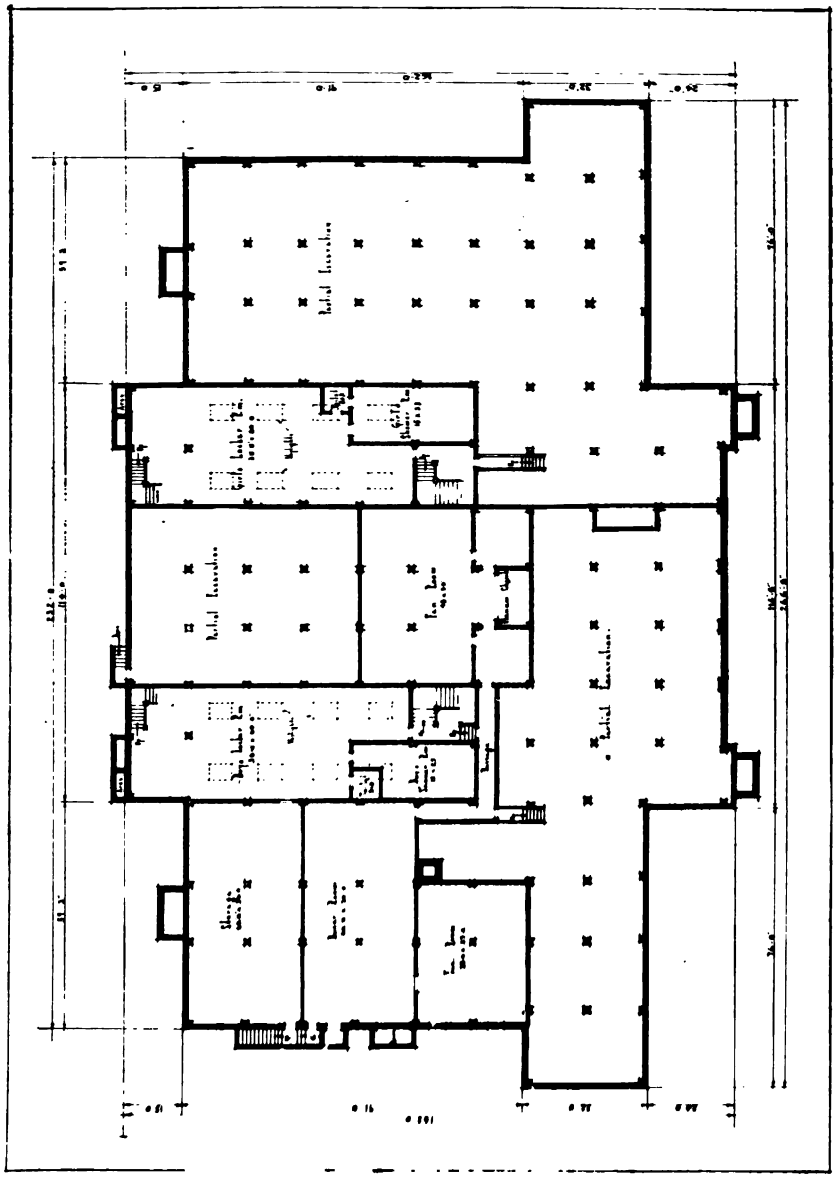


Second Floor Plan

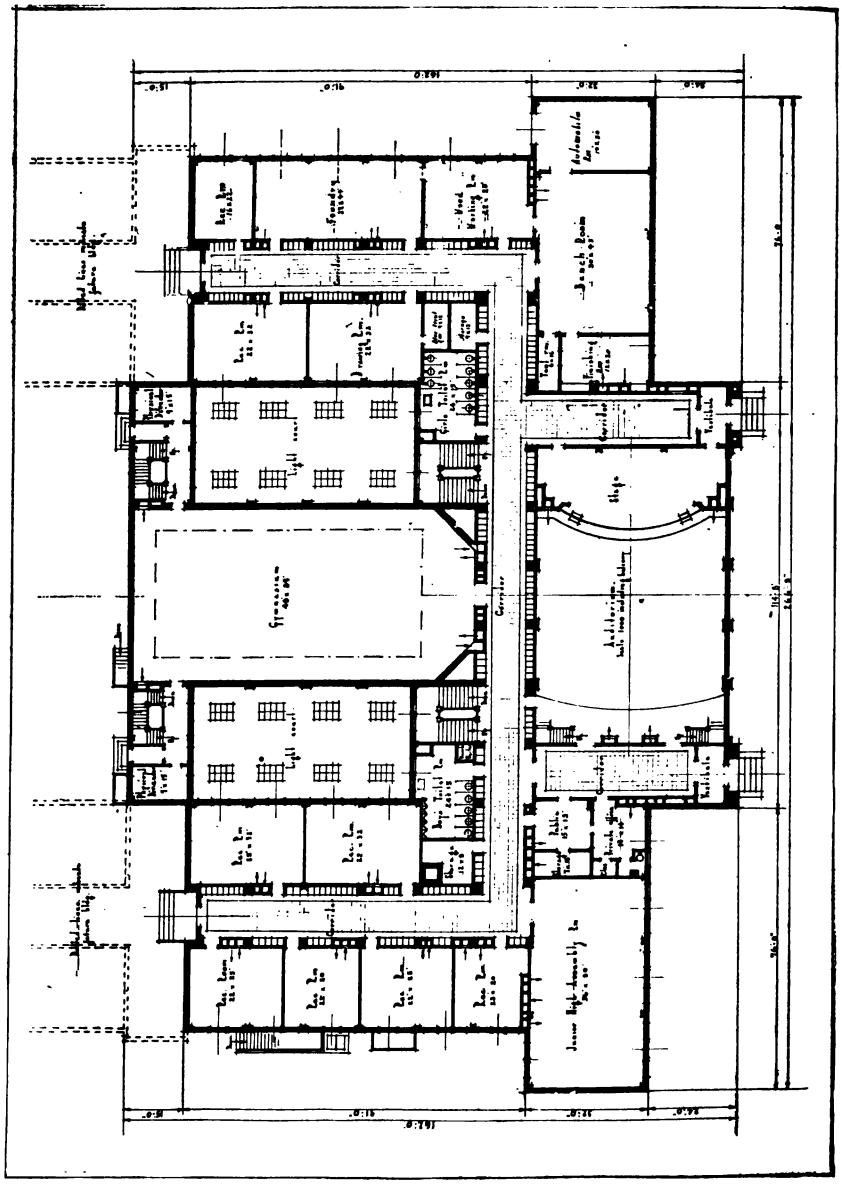


Third Floor Plan

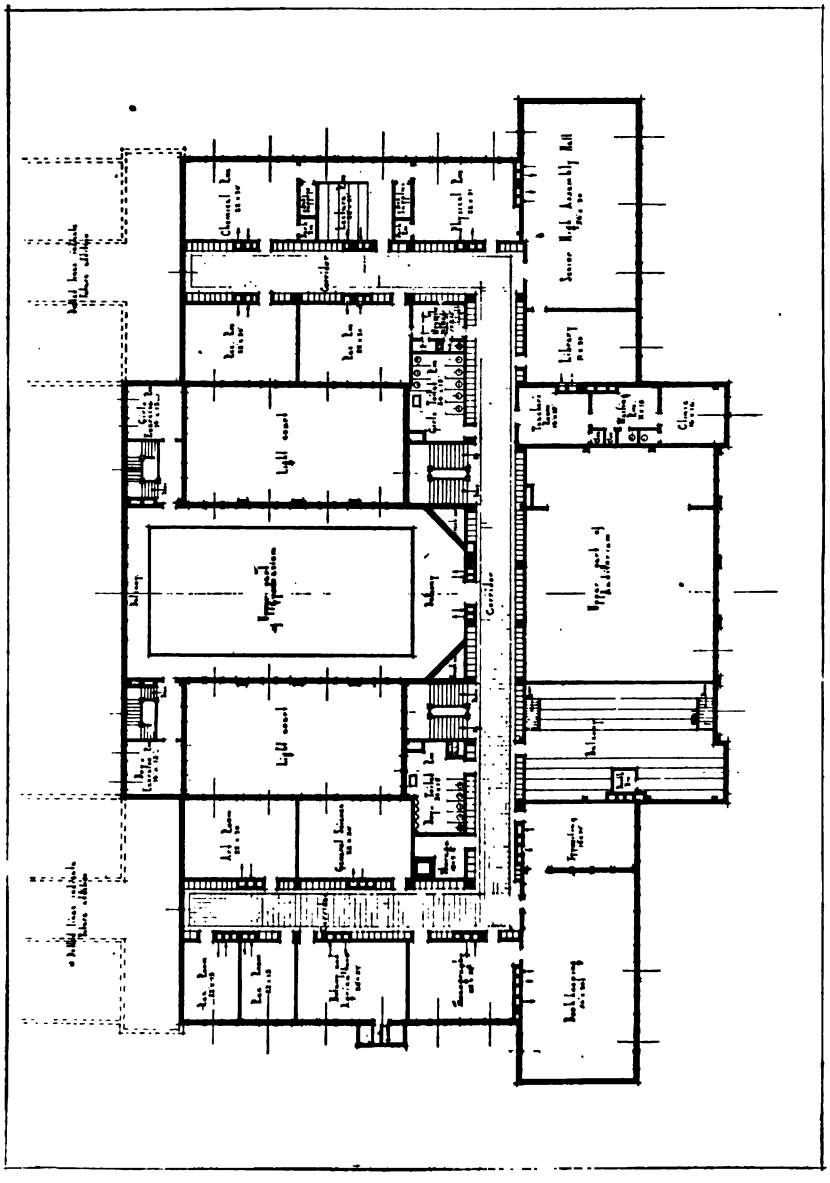
Muskegon Heights High School



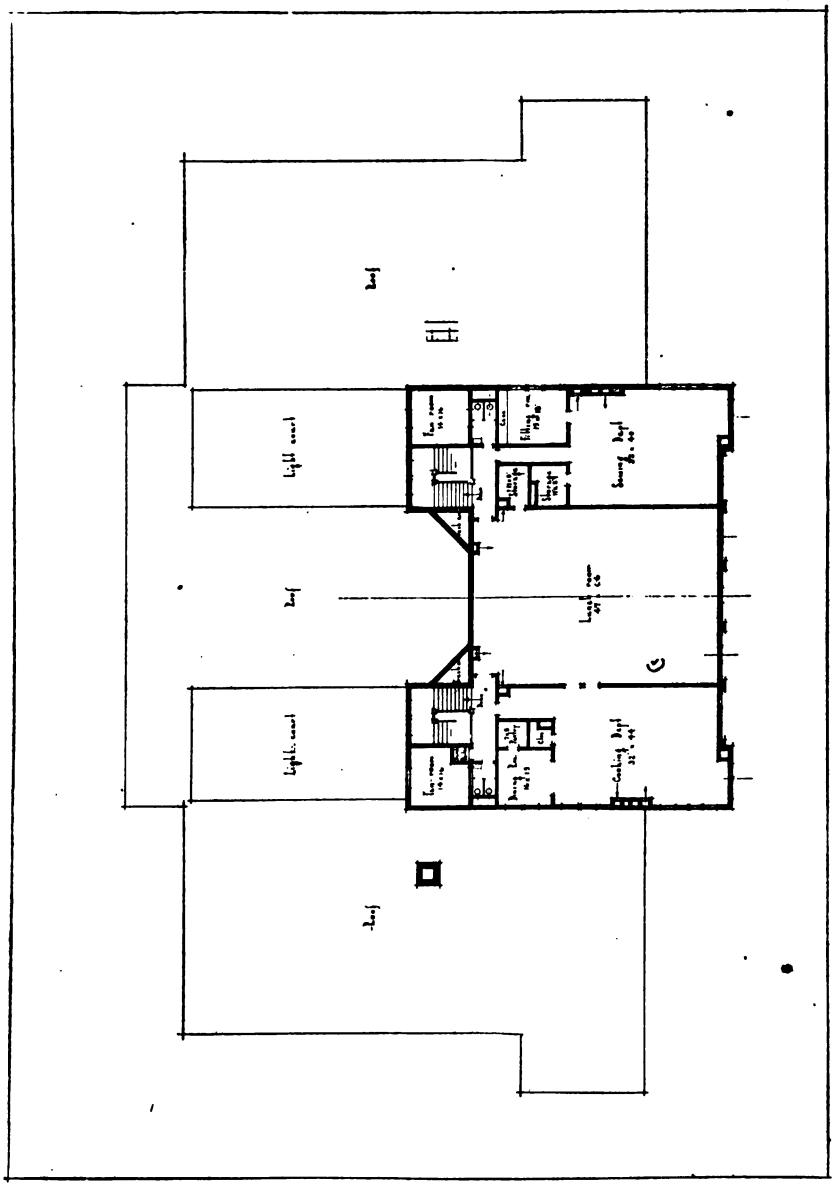
Ground Floor Plan



First Floor Plan

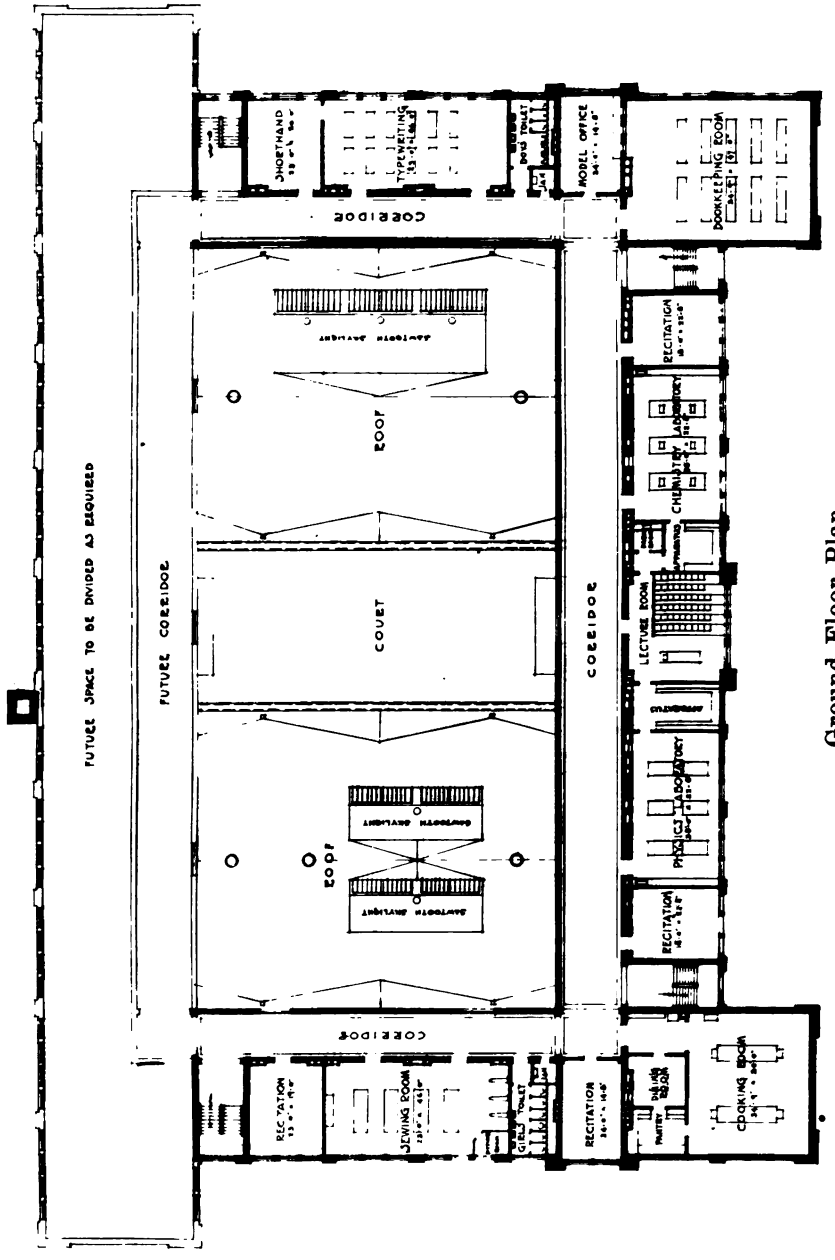


Second Floor Plan

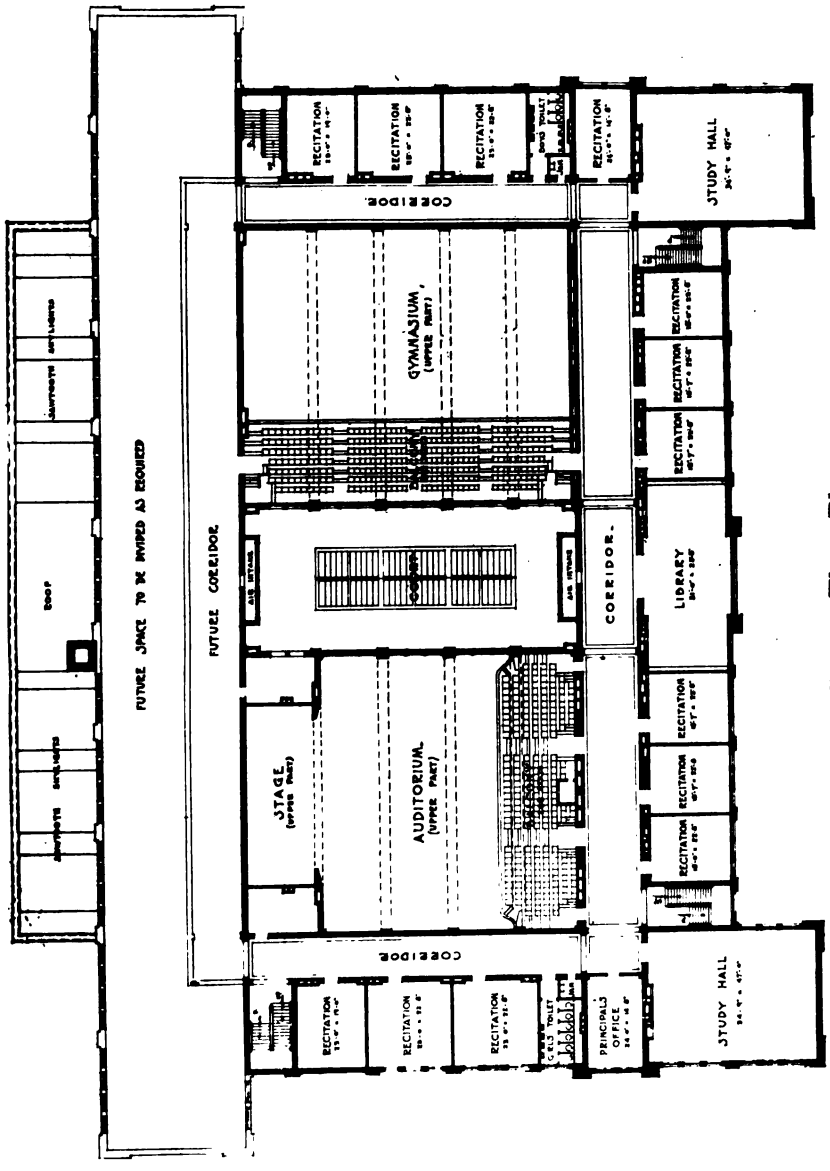


Third Floor Plan

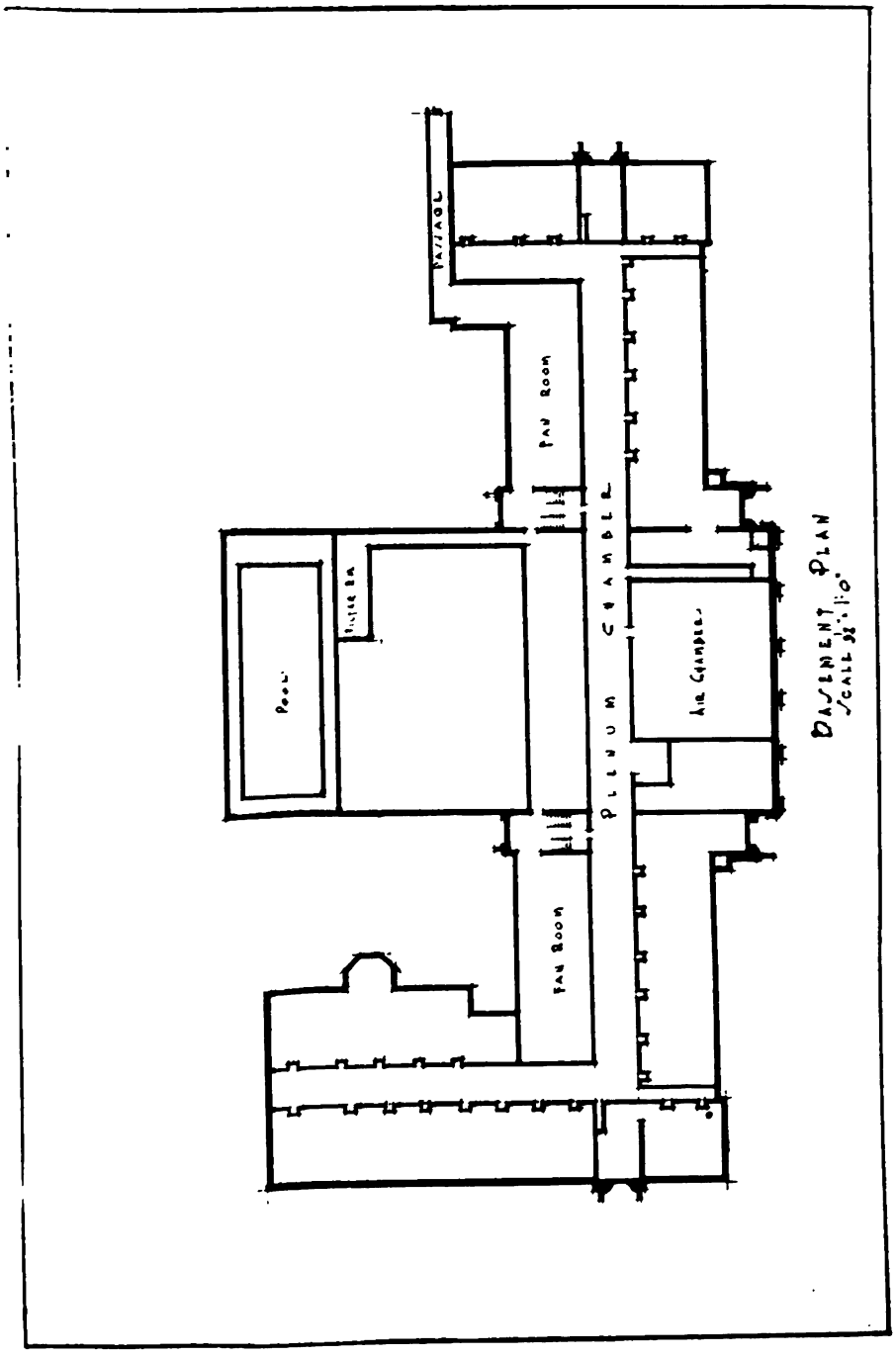
Benton Harbor High School



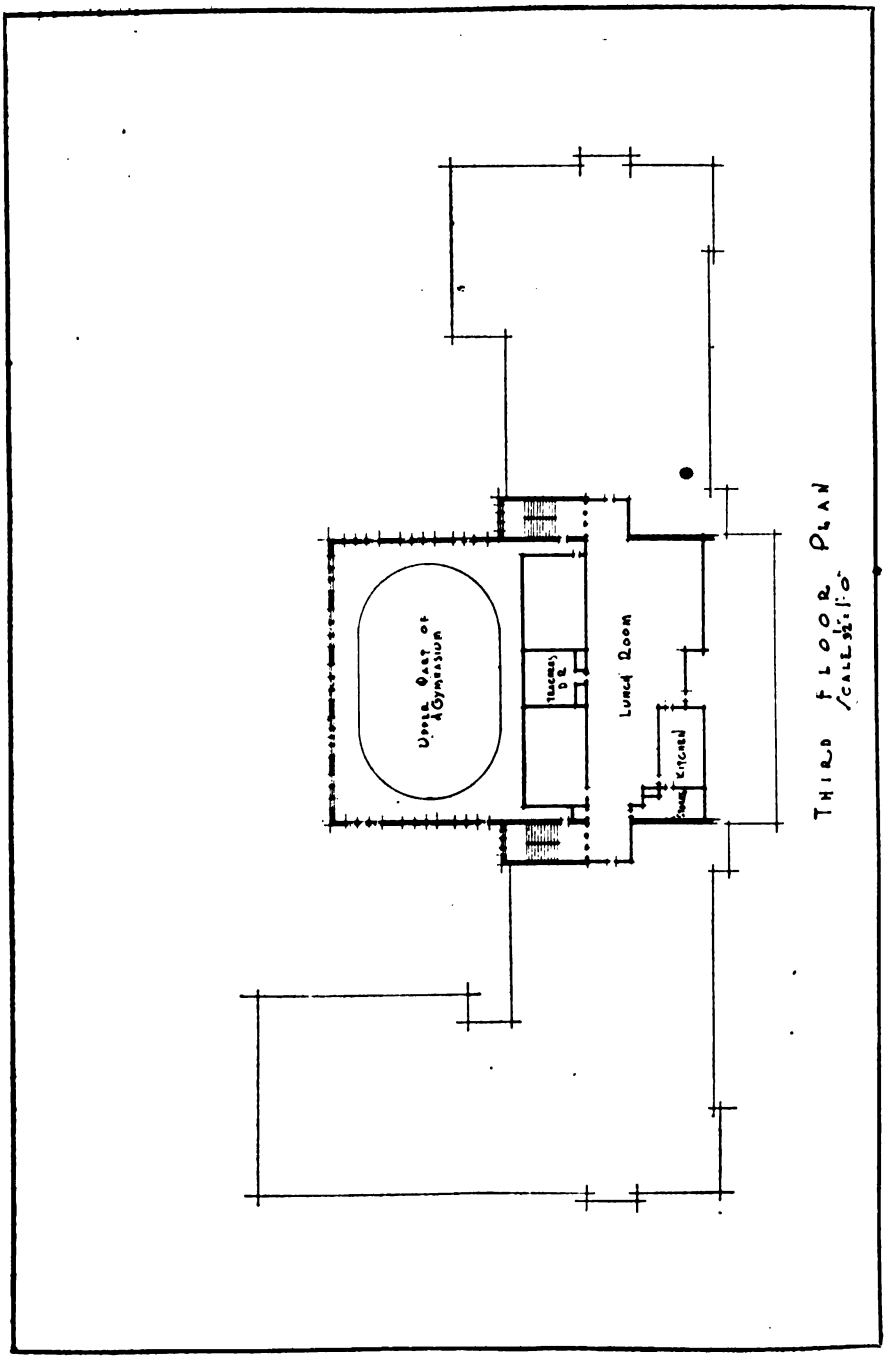
Ground Floor Plan



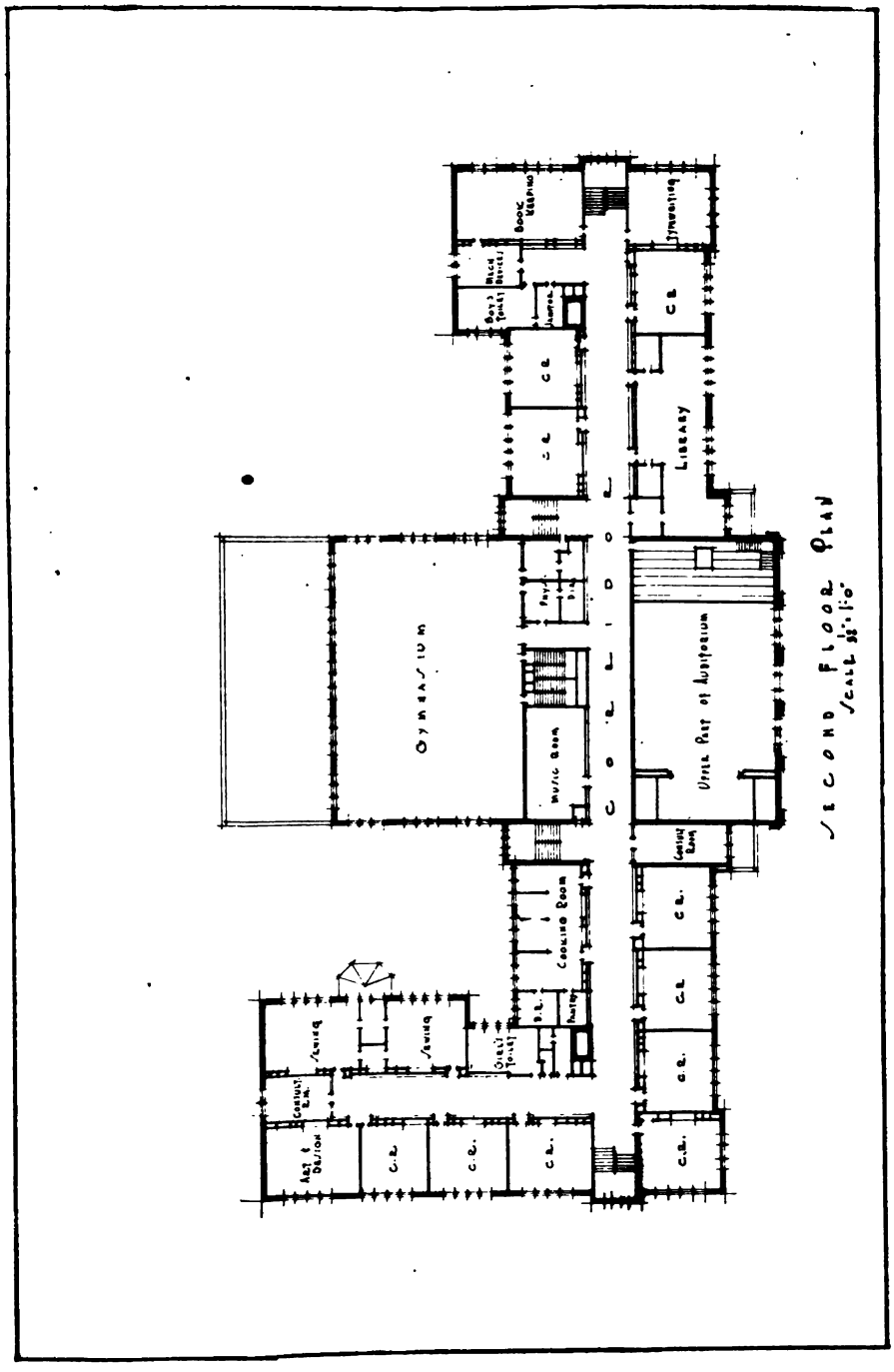
Second Floor Plan



Basement Plan of Southwestern High School, Detroit



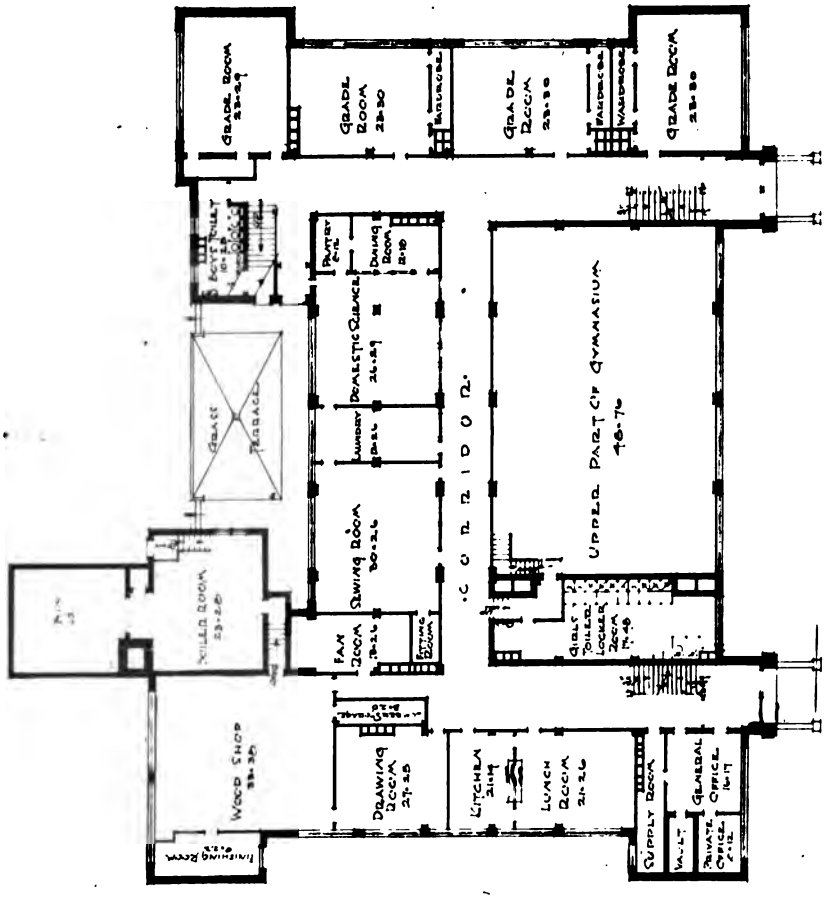
Third Floor Plan of Southwestern High School, Detroit



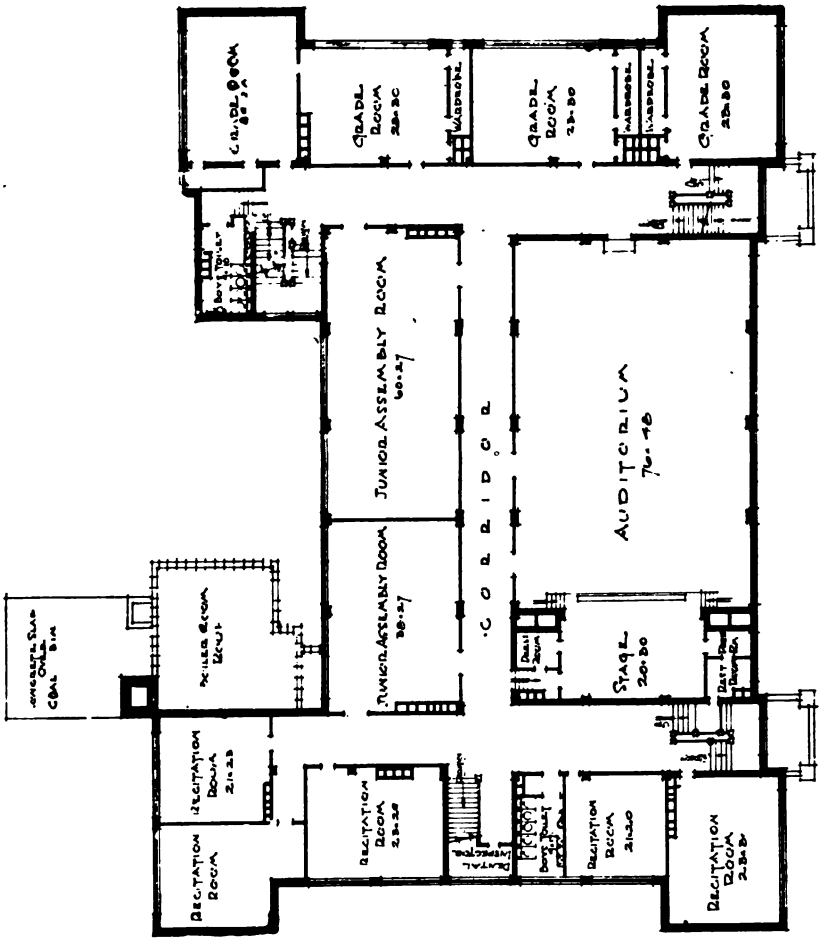
Second Floor Plan of Southwestern High School, Detroit

St. Joseph High School

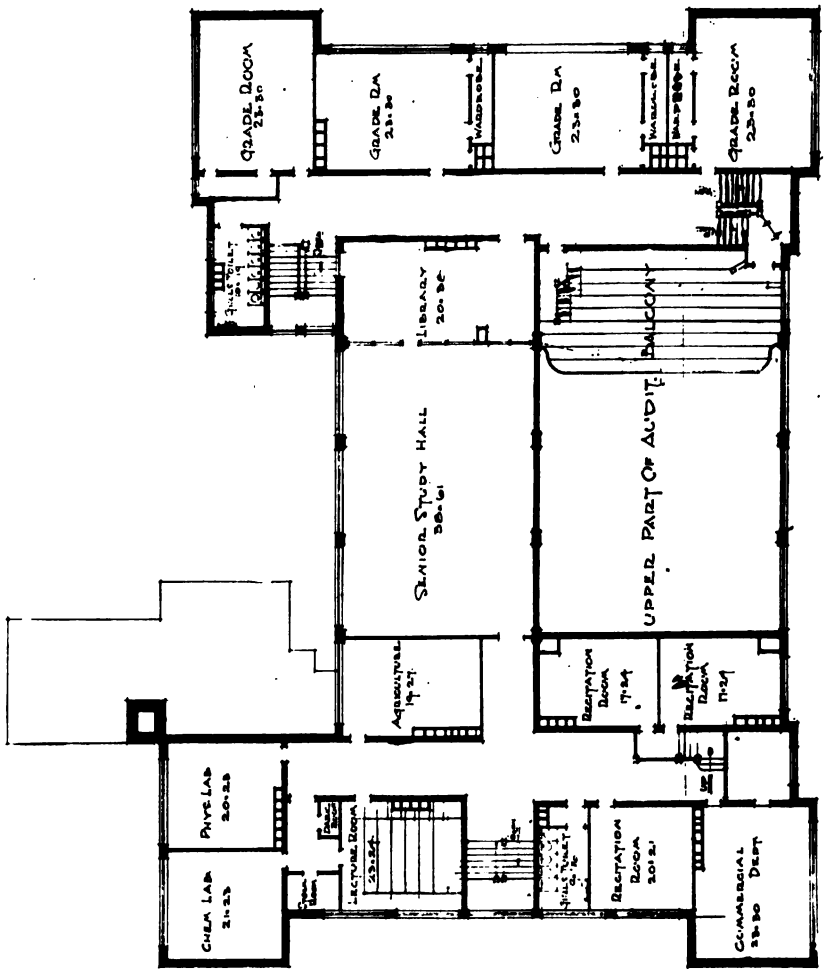
Howell School



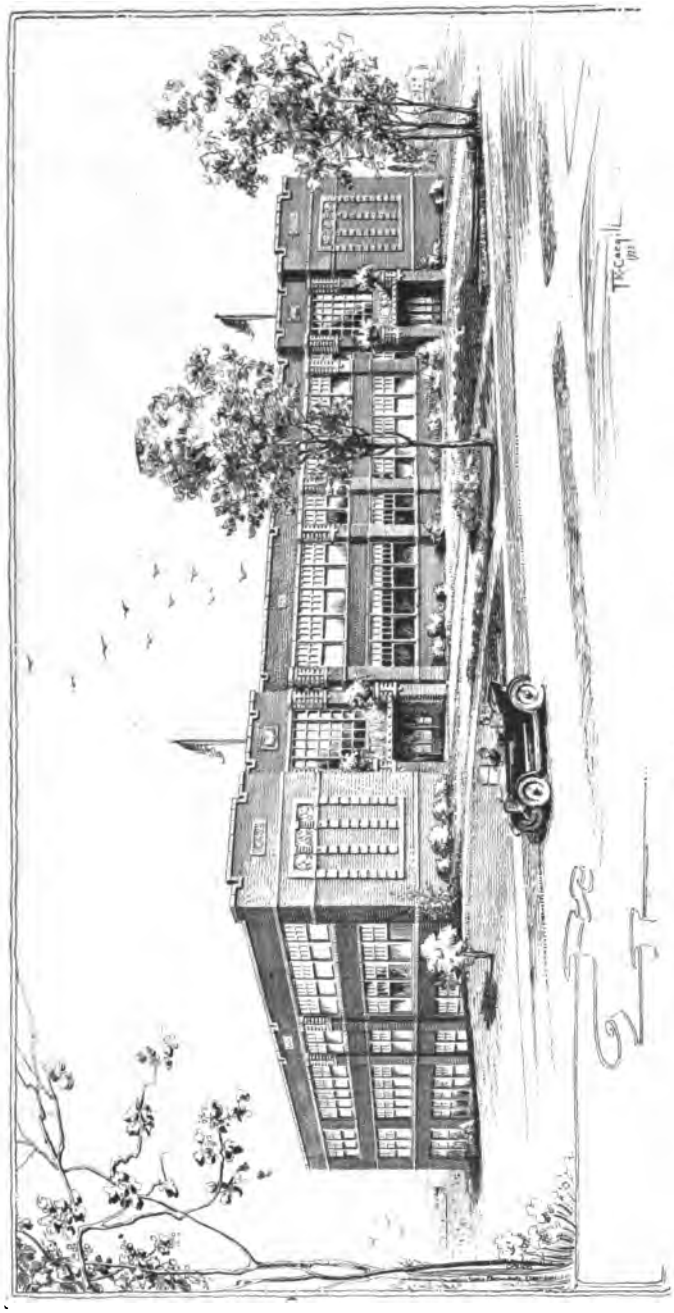
Ground Floor Plan



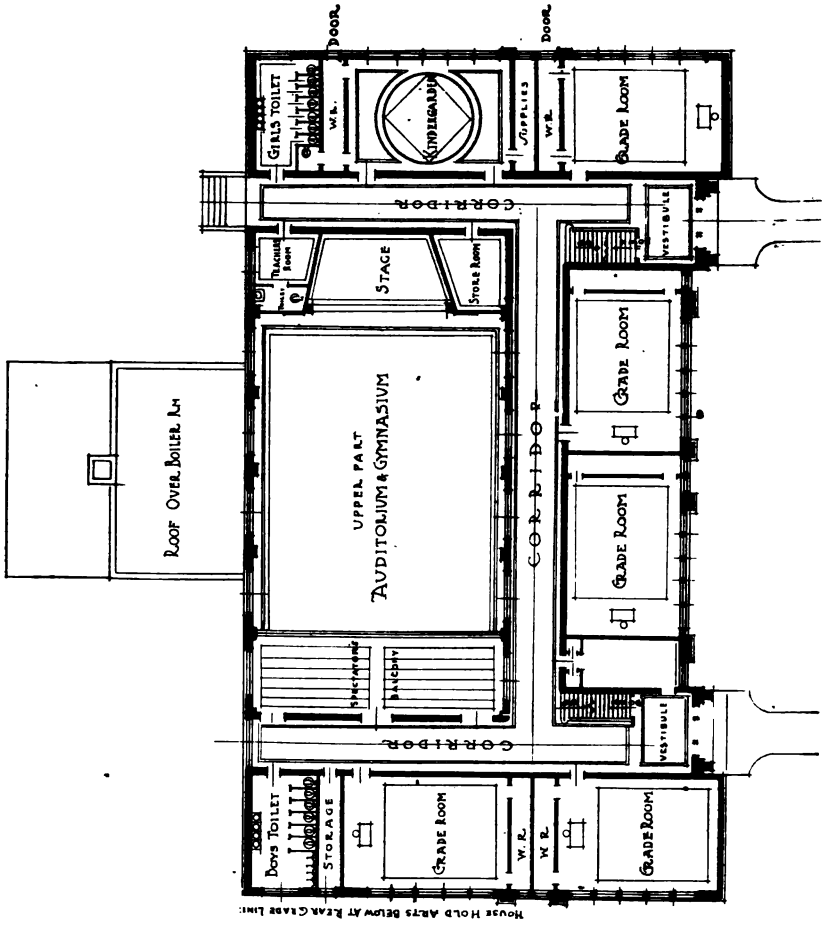
First Floor Plan



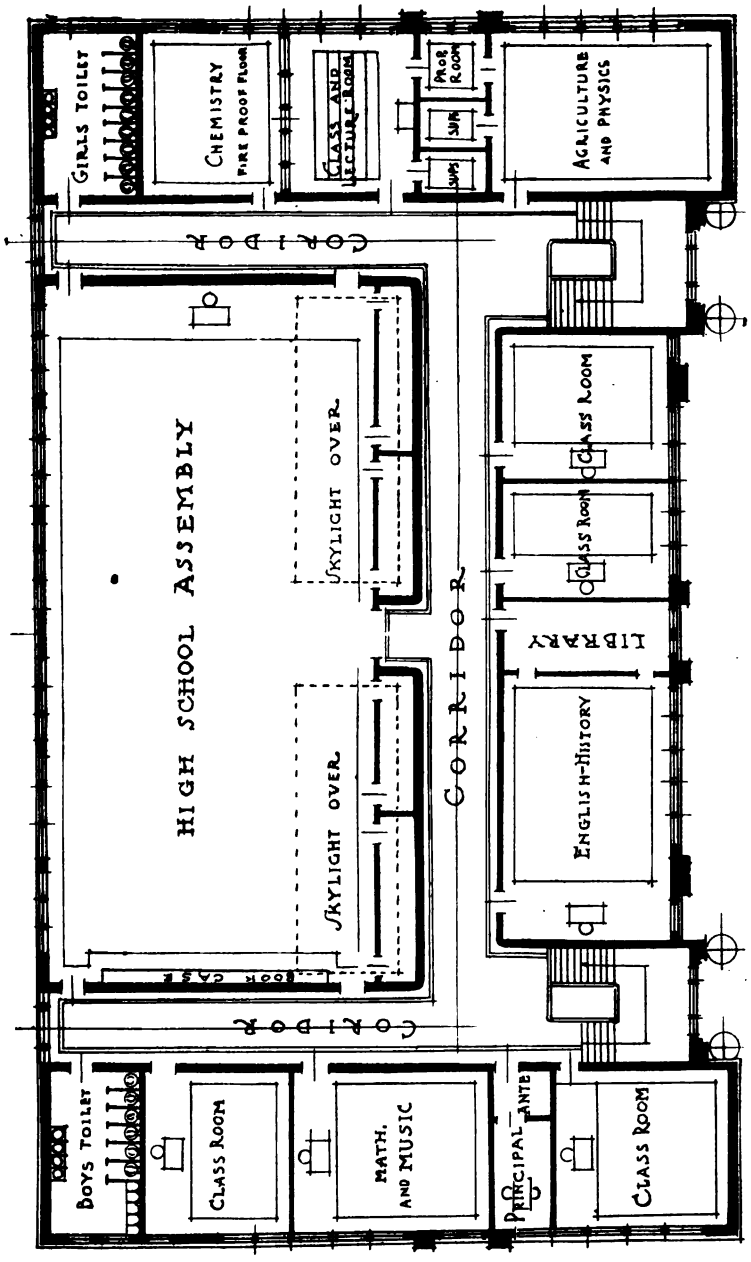
Second Floor Plan



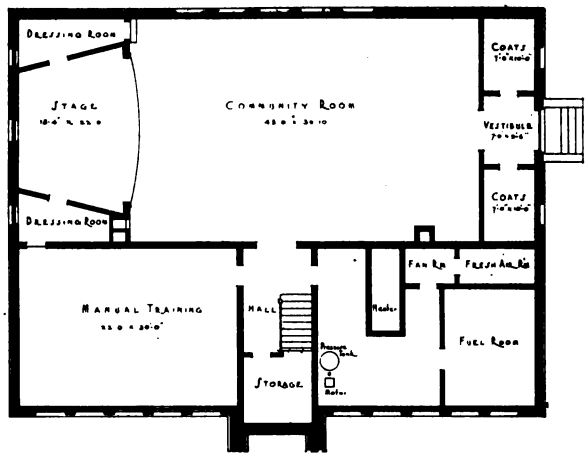
Lake Odessa School



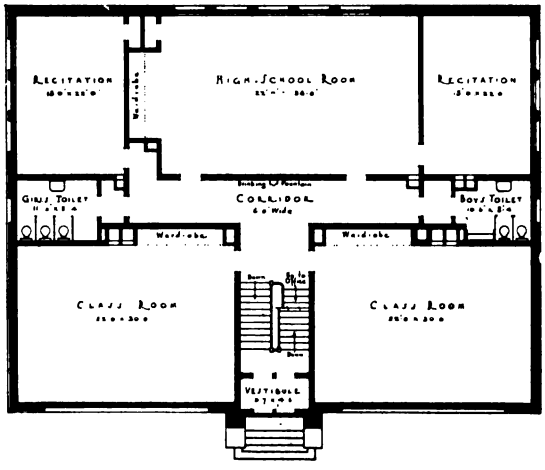
First Floor Plan



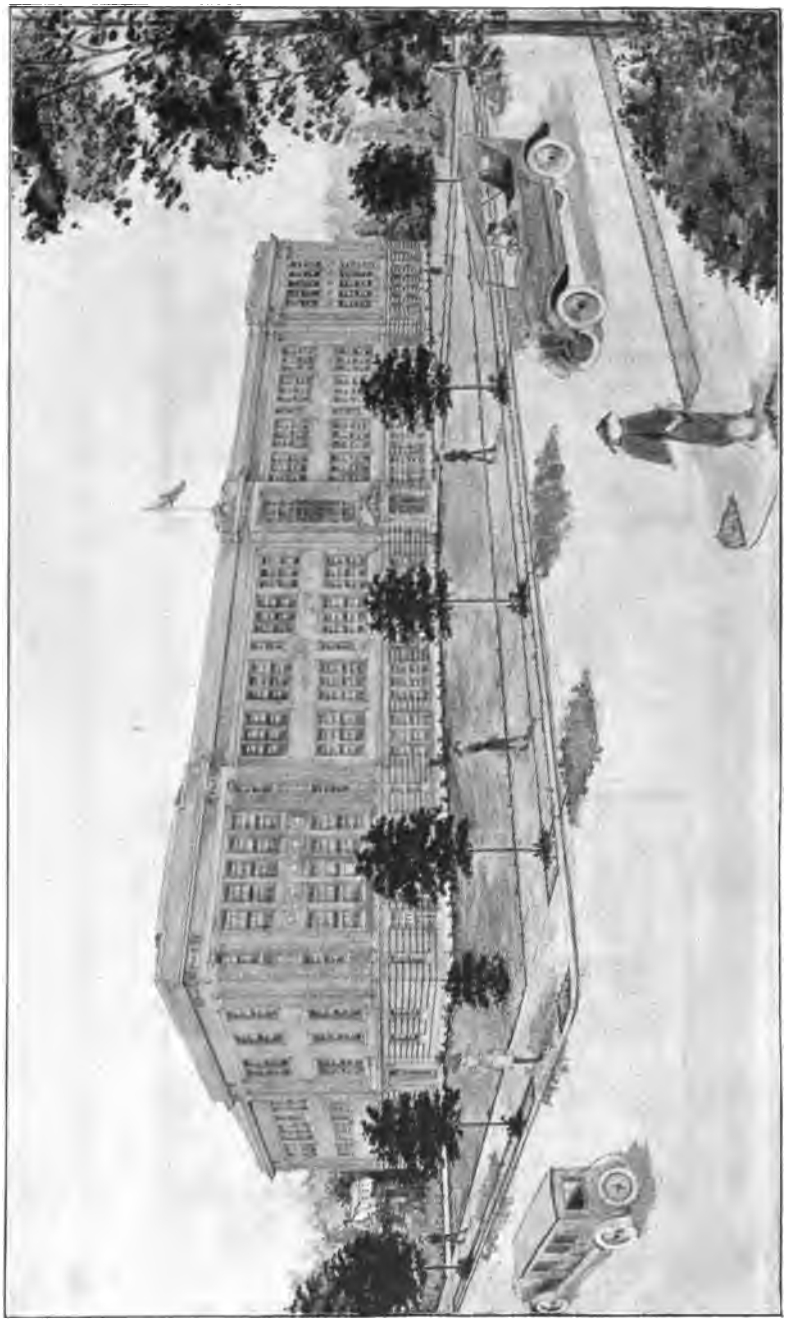
Second Floor Plan



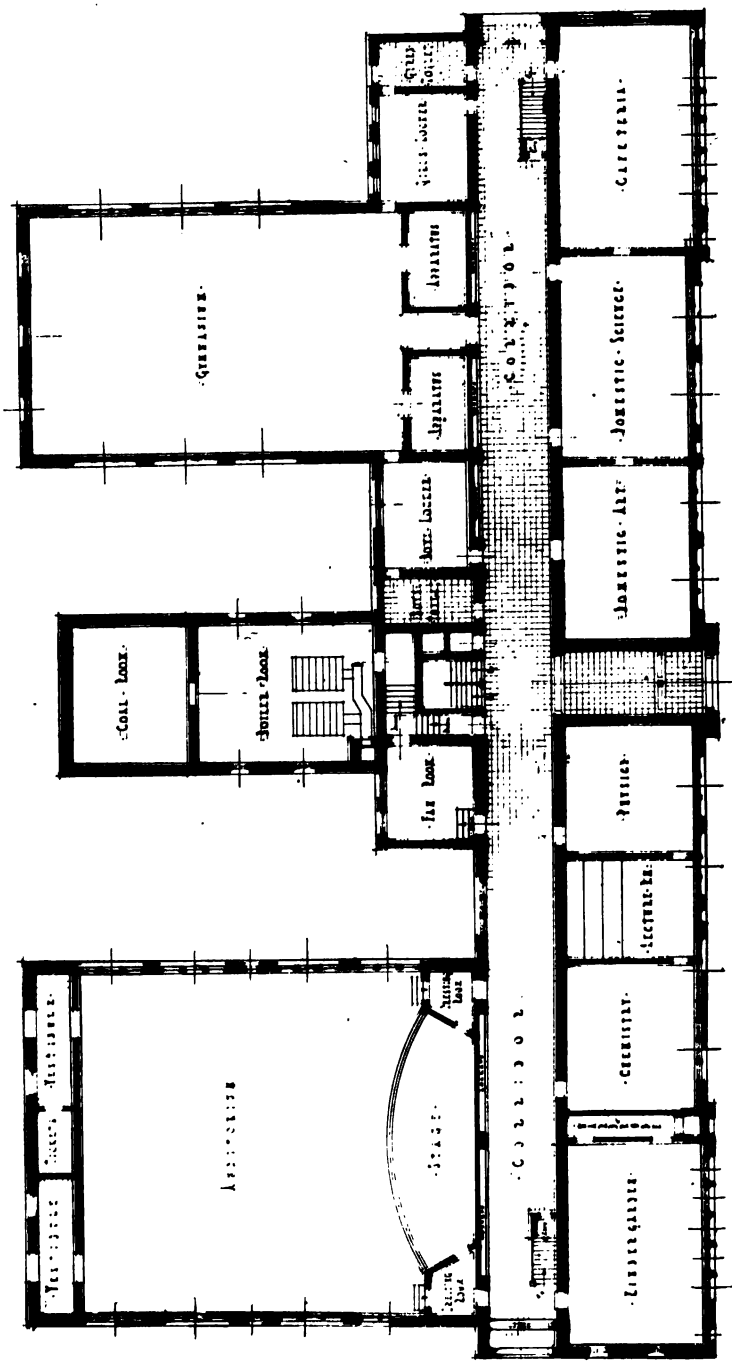
Mio Ground Floor Plan



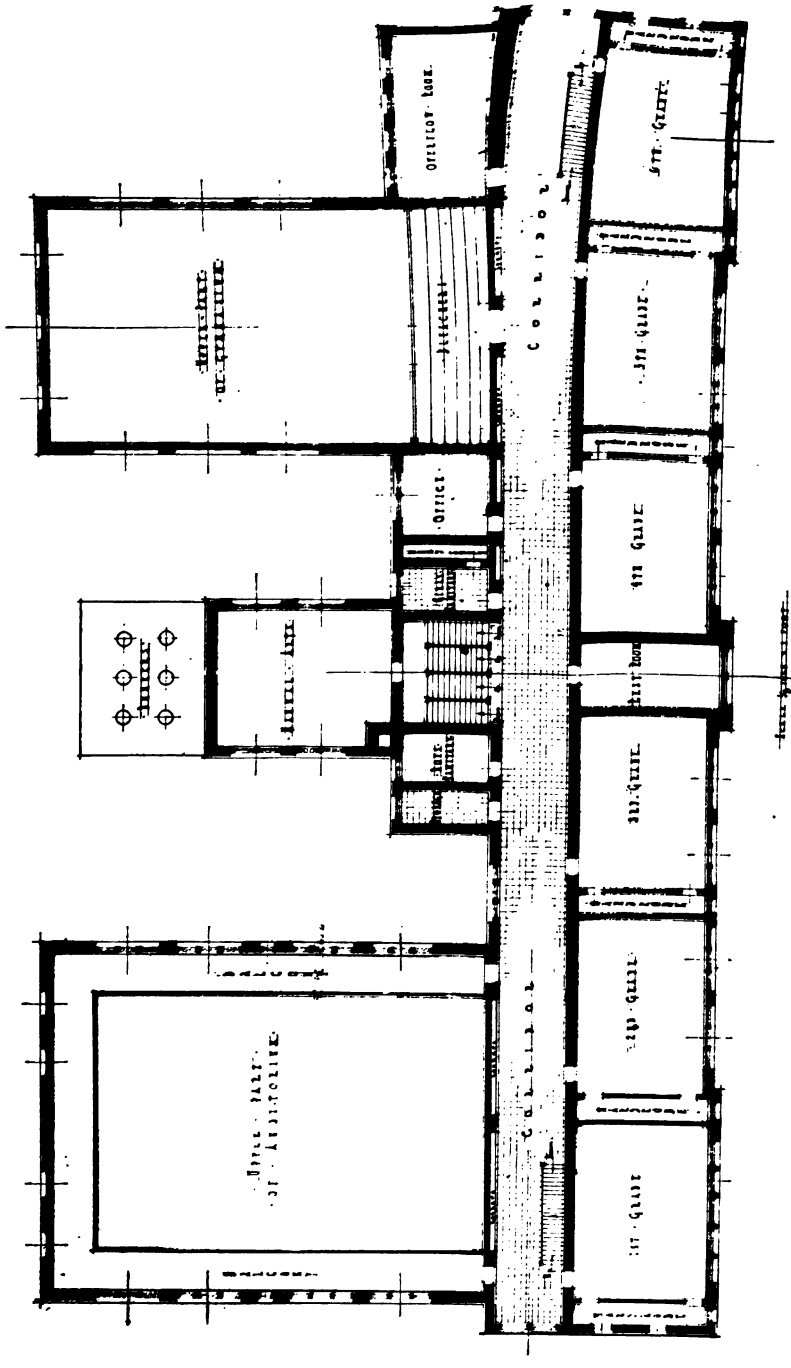
Mio First Floor Plan



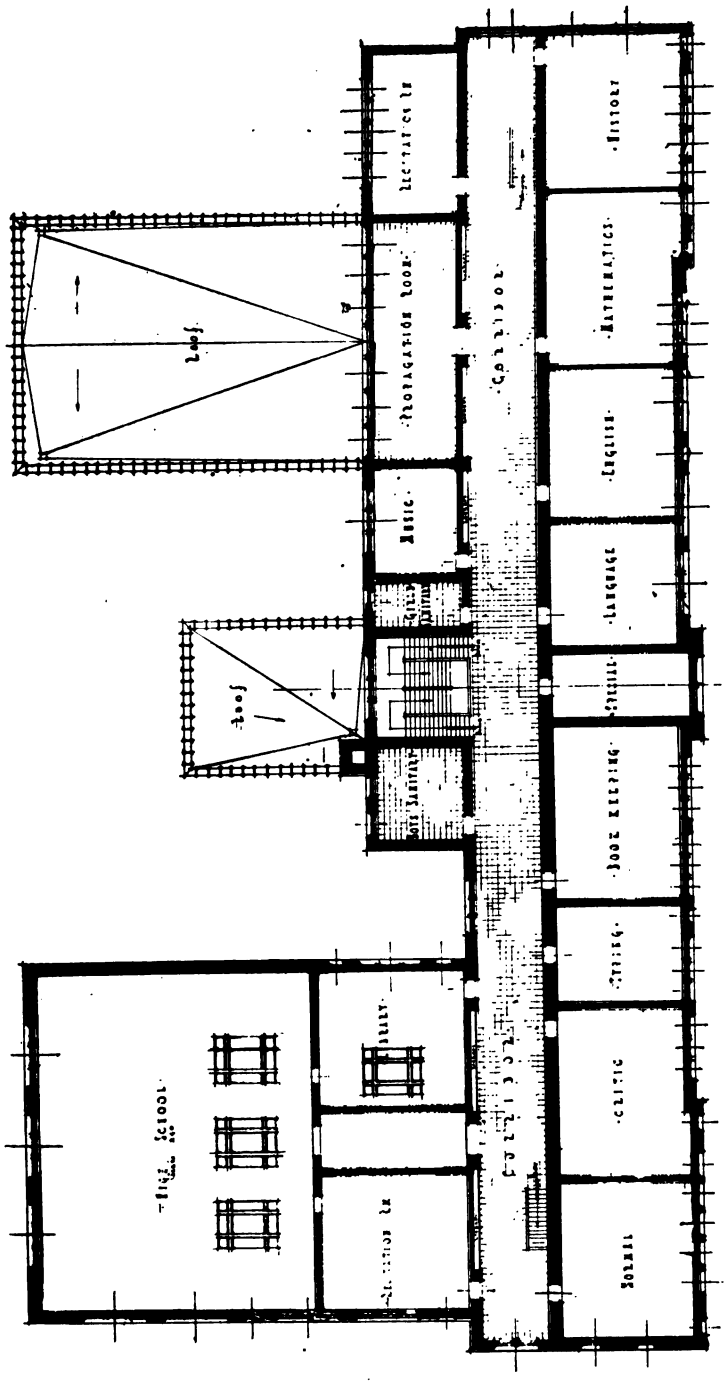
Evart School



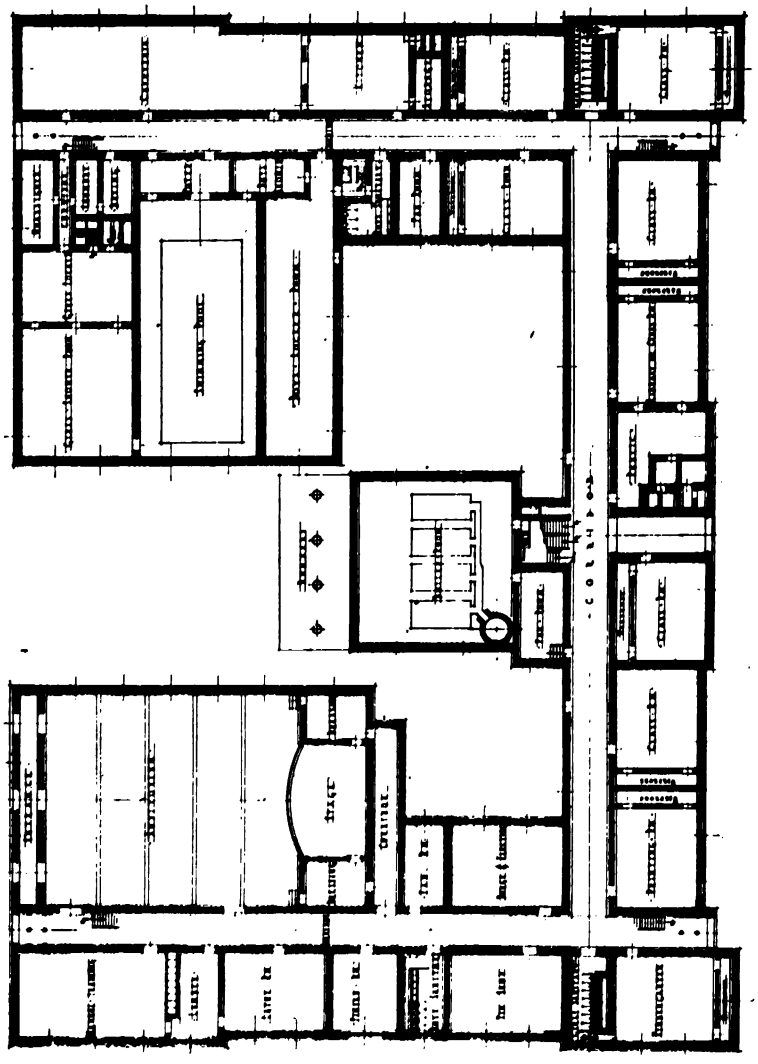
First Floor Plan



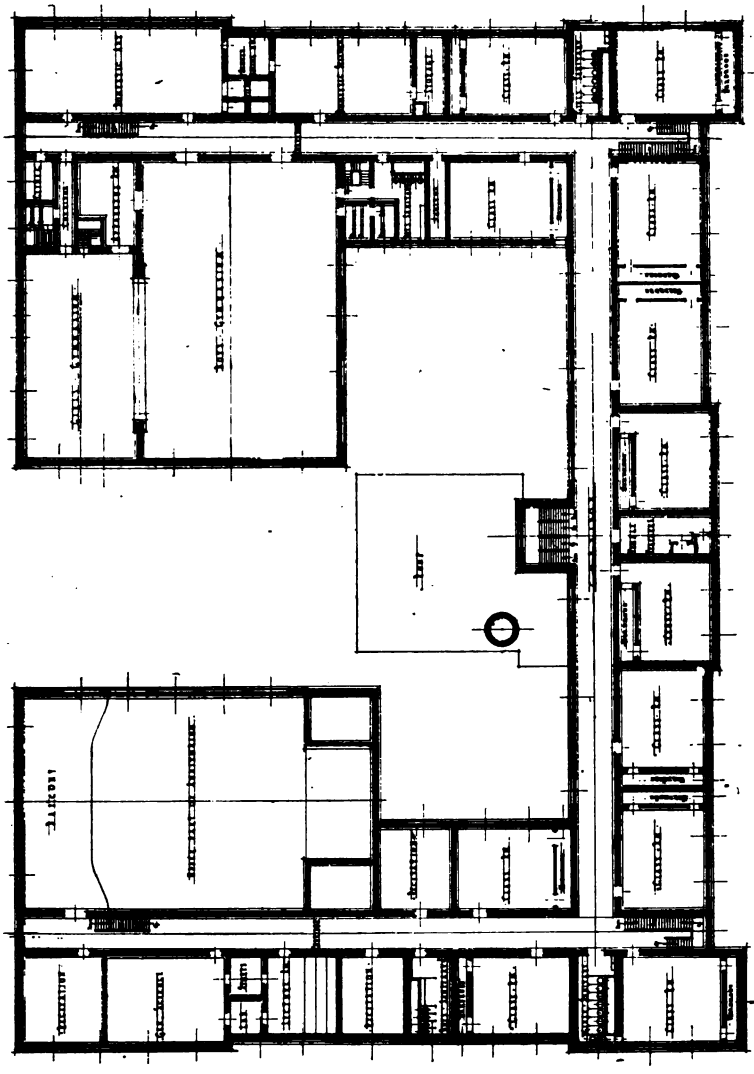
Second Floor Plan


Roof
Roof
Music
Corridor
History
Mathematics
English
Language
Book Keeping
Drawing
Science
Toilets
Corridor
Third Floor Plan

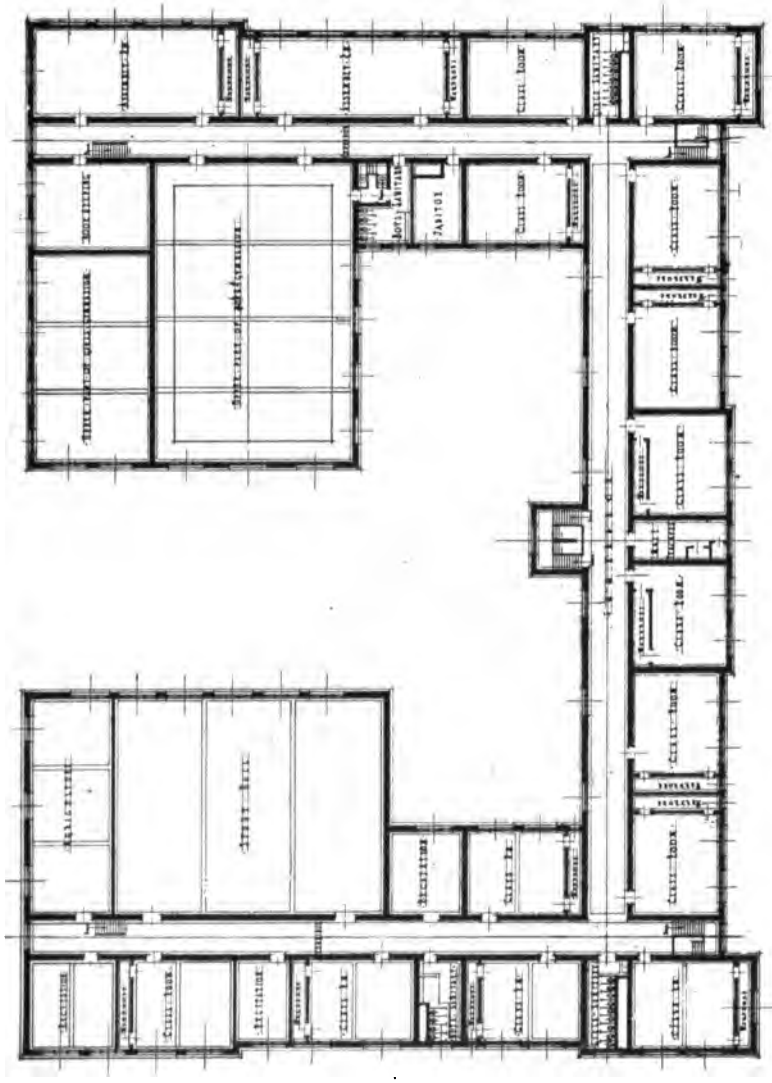
Henry R. Pattengill Junior High School, Lansing



Ground Floor Plan

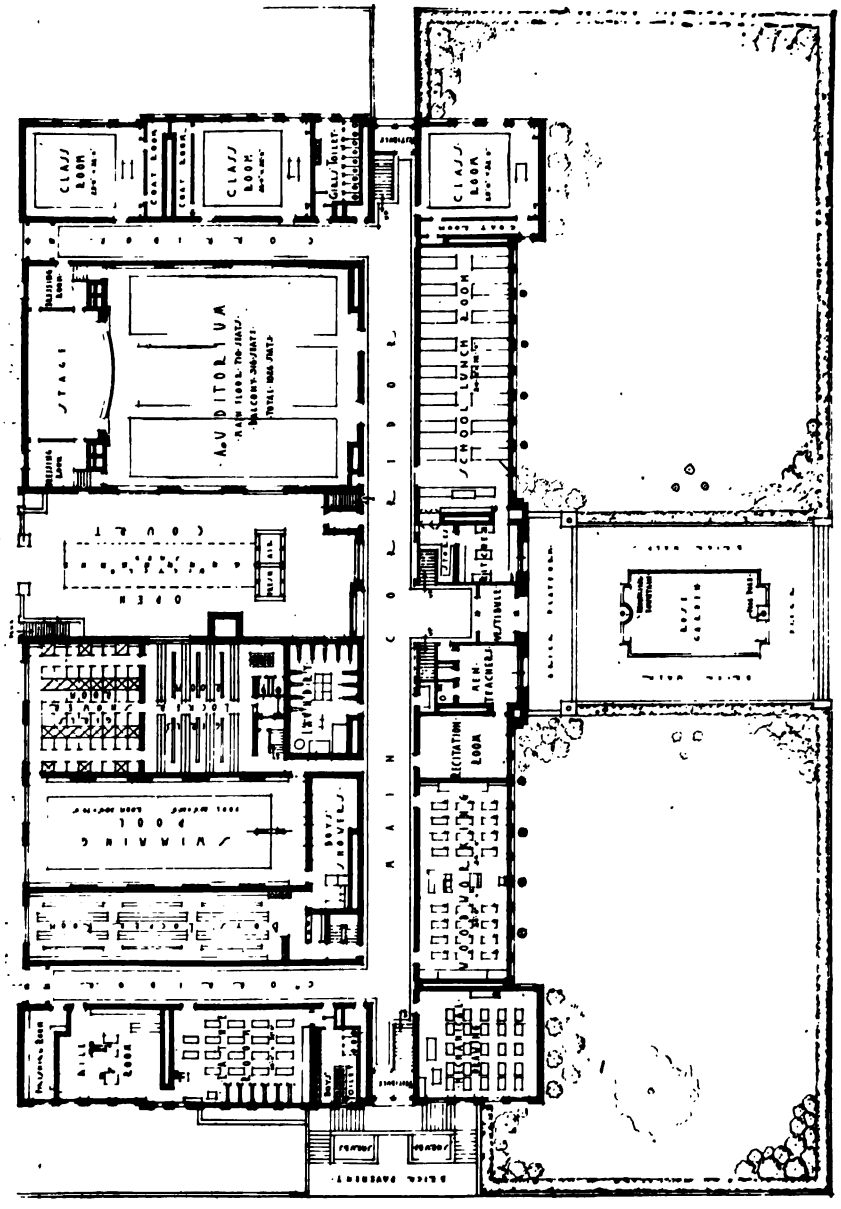


First Floor Plan

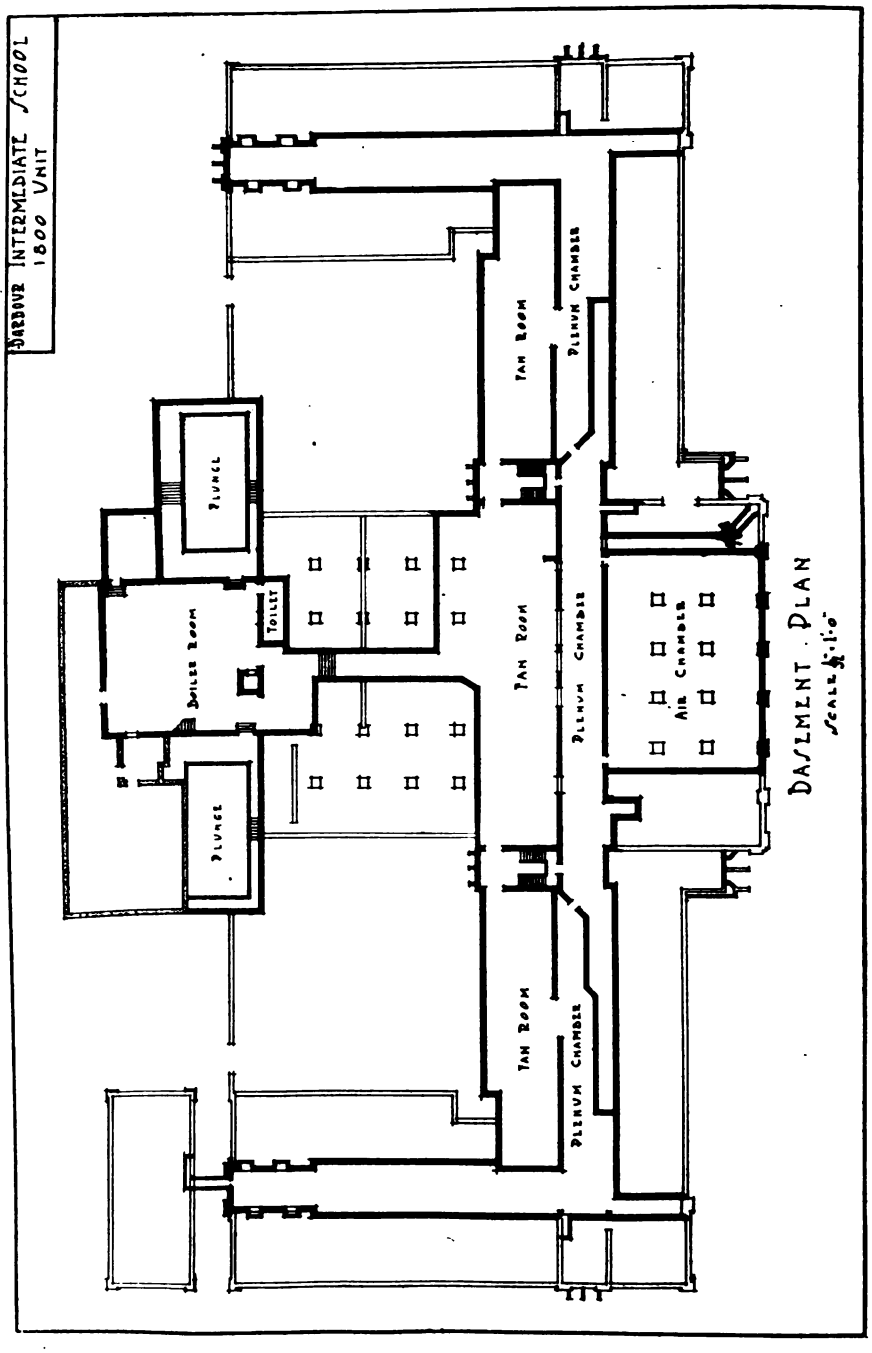


Second Floor Plan

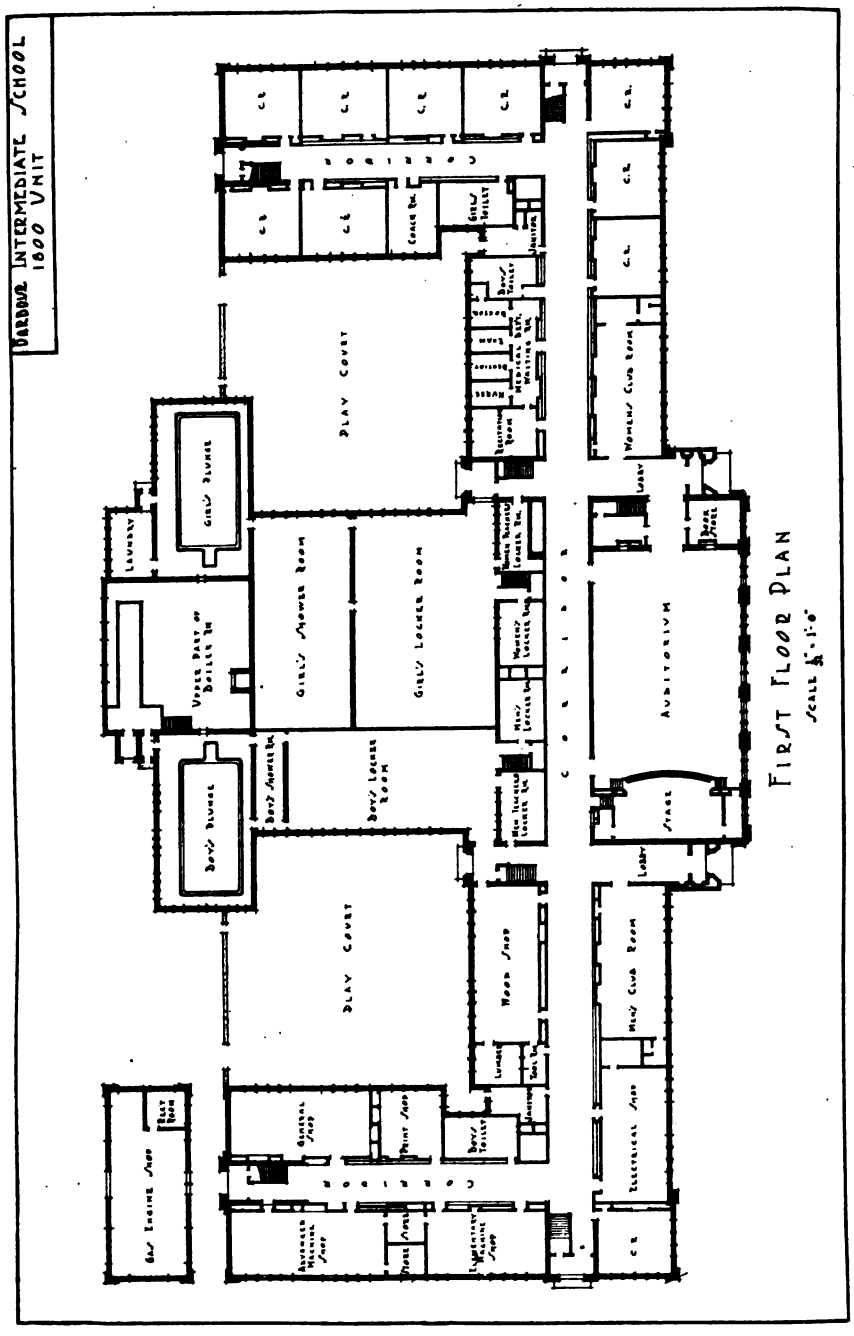
West Intermediate School, Jackson



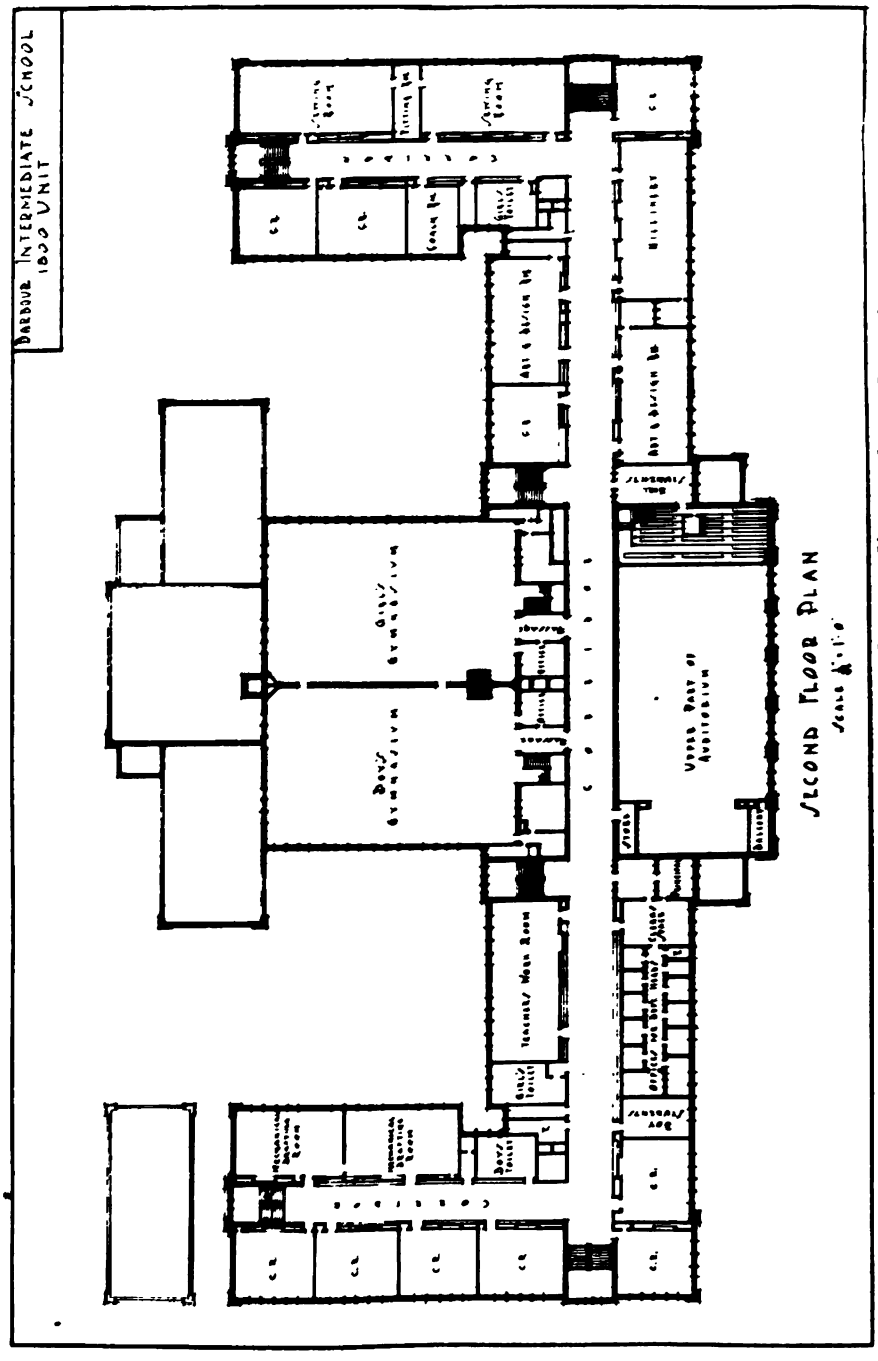
First Floor Plan



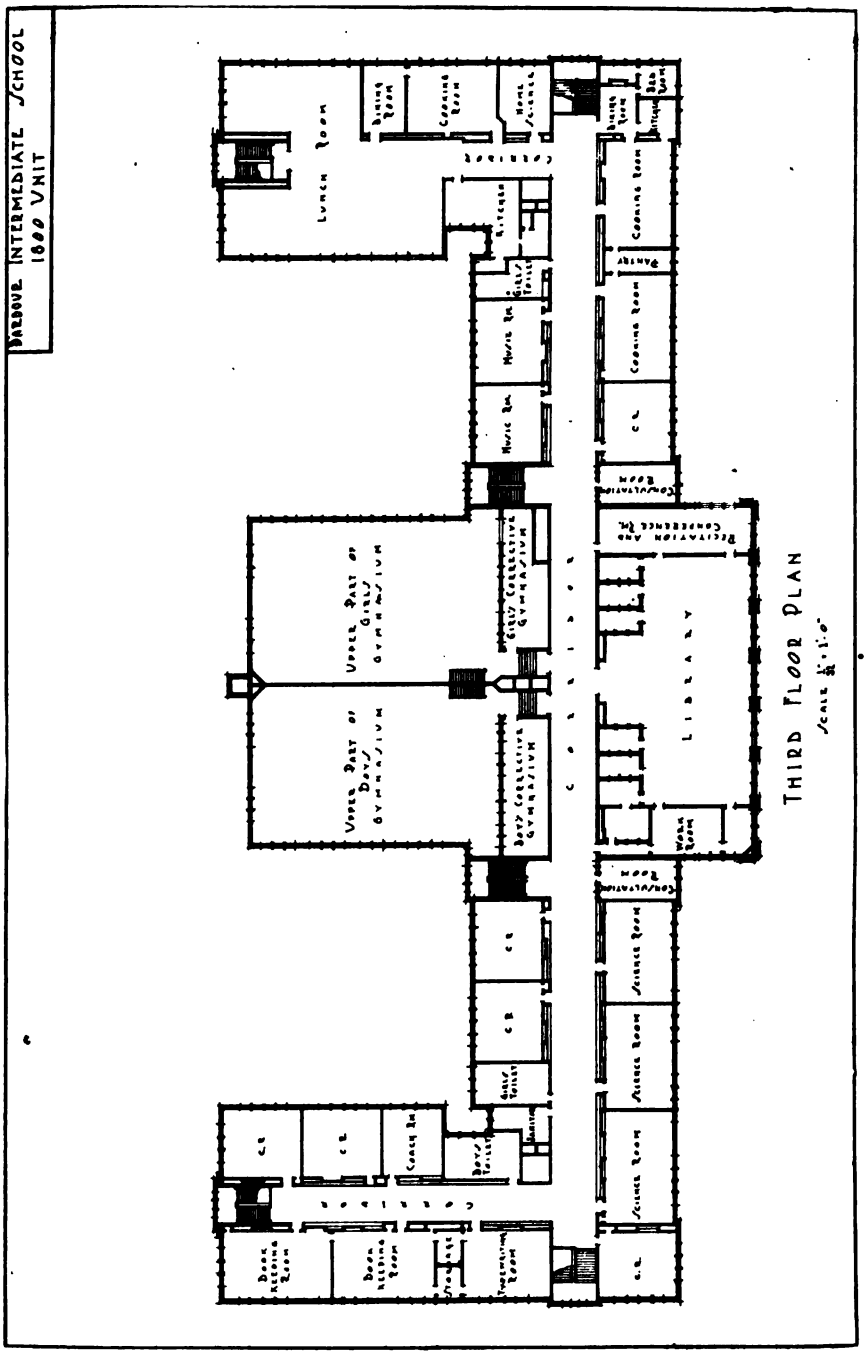
Basement Floor Plan of Barbour Intermediate School, Detroit



First Floor Plan of Barbour Intermediate School, Detroit



Second Floor Plan of Barbour Intermediate School, Detroit

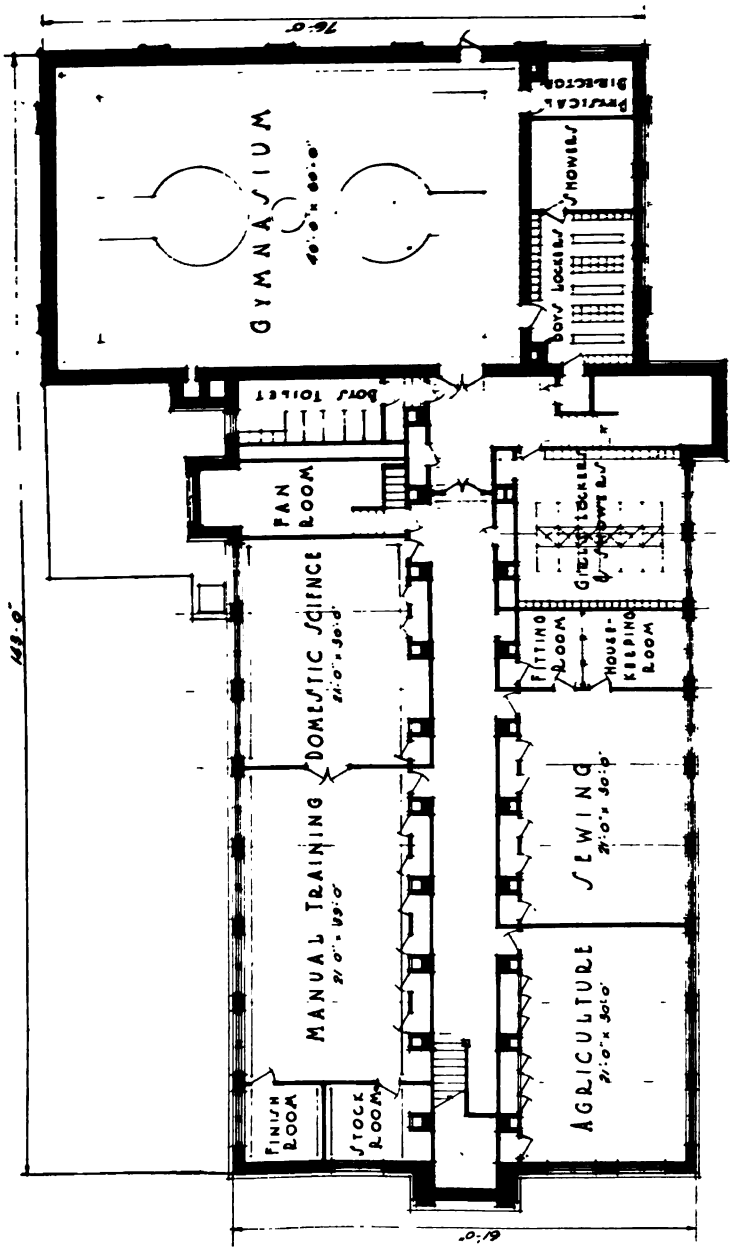


Third Floor Plan of Barbour Intermediate School, Detroit

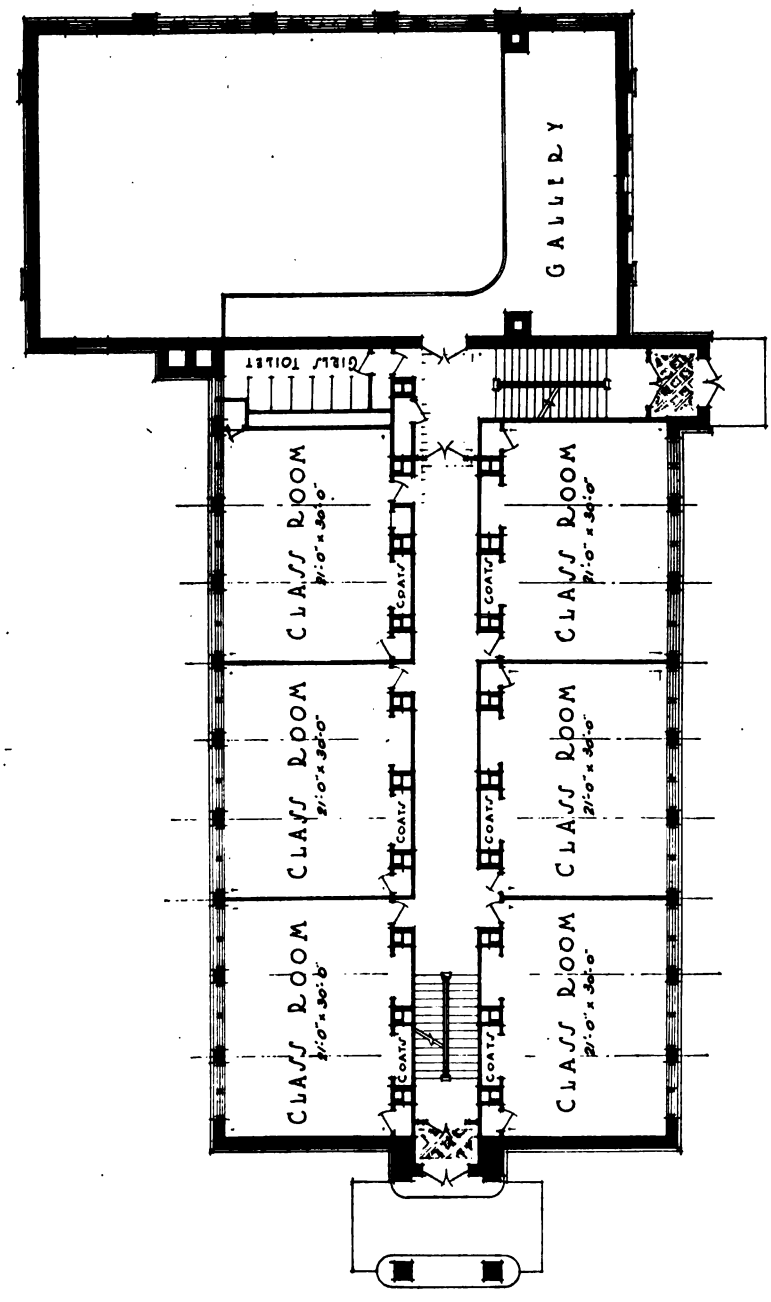
Fourth Floor Plan of Baldwin Intermediate School Detroit

CONSOLIDATED SCHOOLS OPERATING UNDER THE RURAL AGRICULTURAL ACT

Grand Blanc Consolidated School, Genesee County



Ground Floor Plan



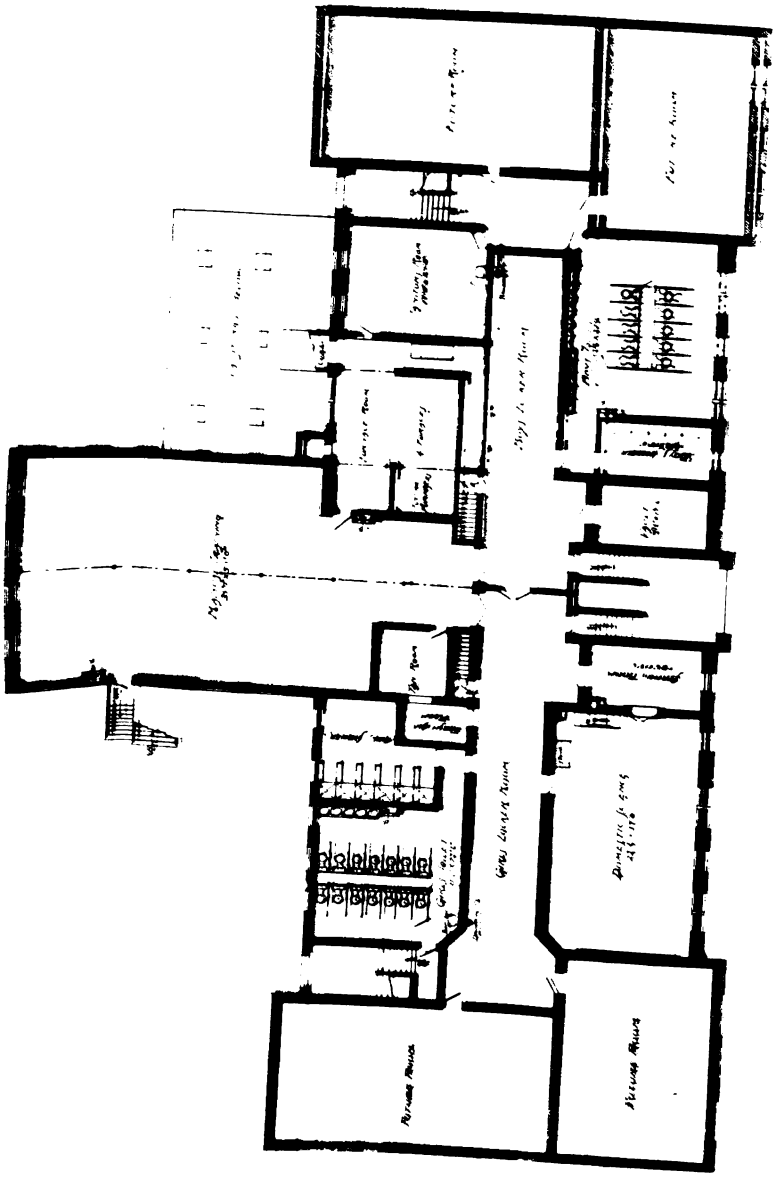
First Floor Plan

Second Floor Plan

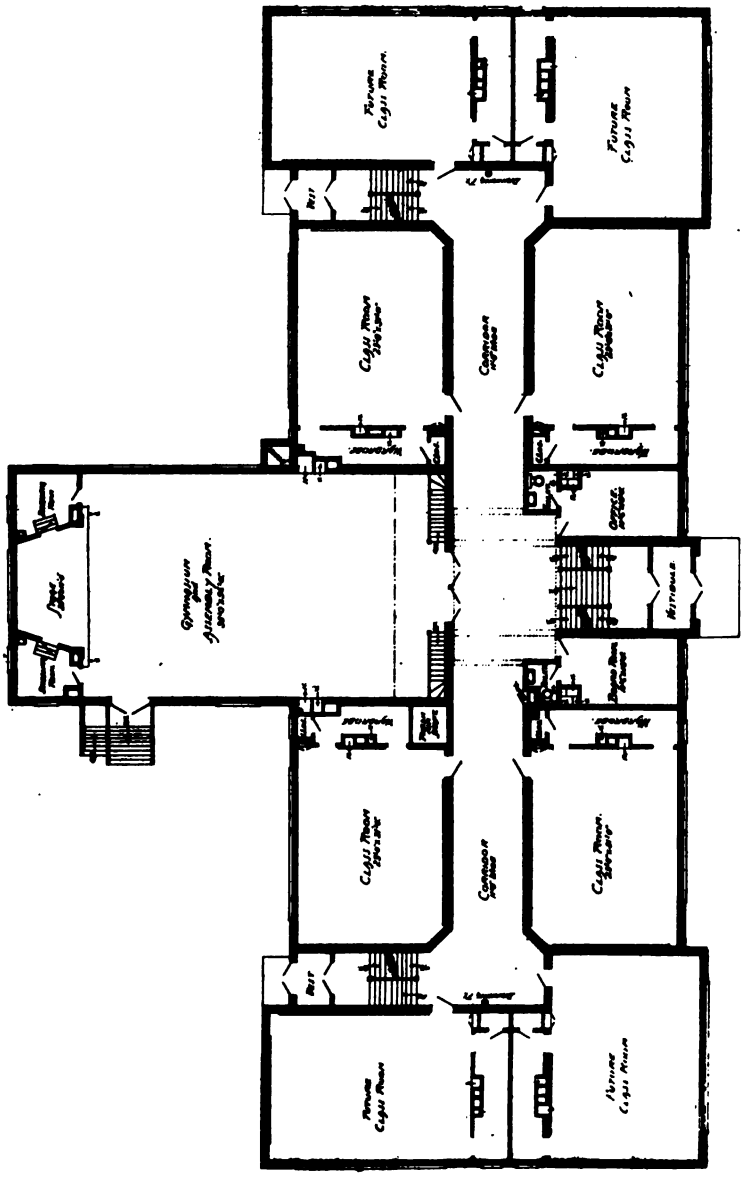
Manual Training Room, Grand Blanc Consolidated School

Combination Physics and Chemistry Laboratory, Grand Blanc Junior High School

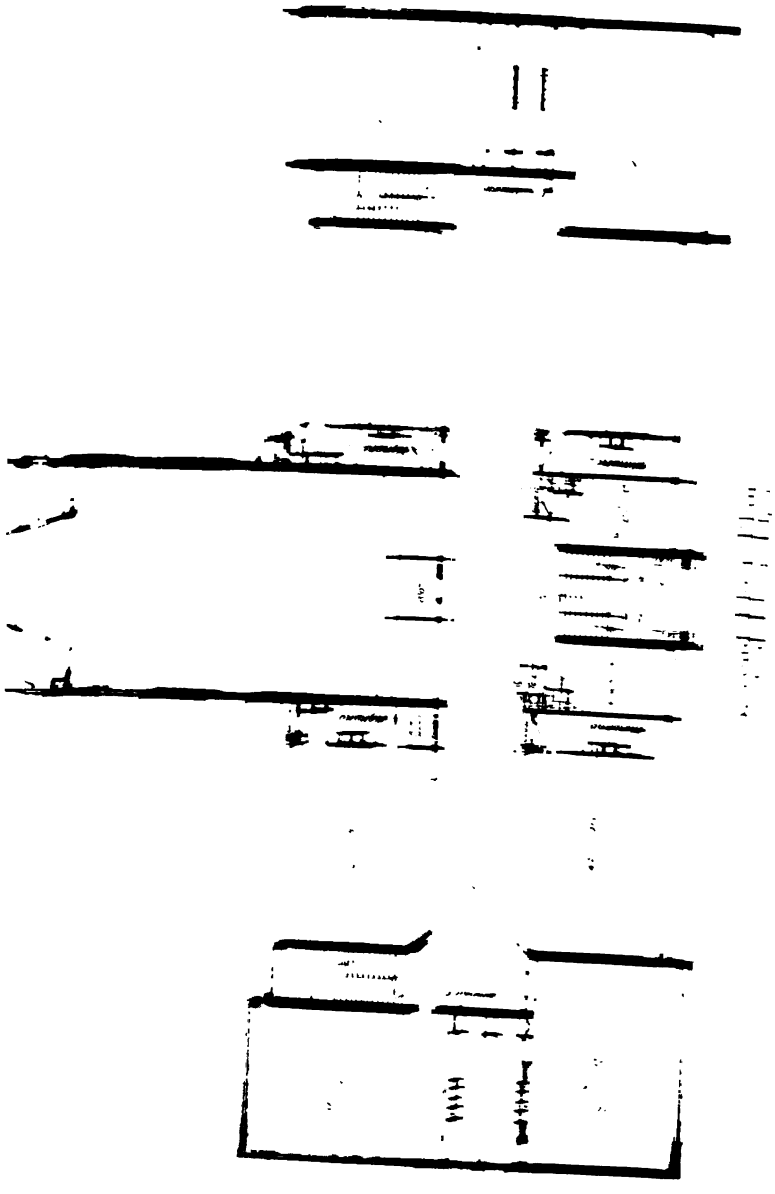
Lakeview Consolidated School, Battle Creek Township, Calhoun County.



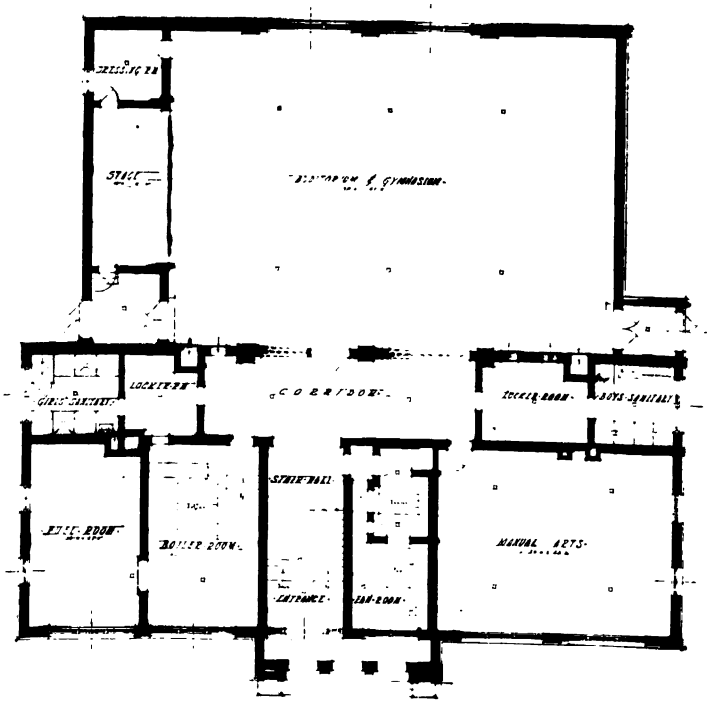
Ground Floor Plan



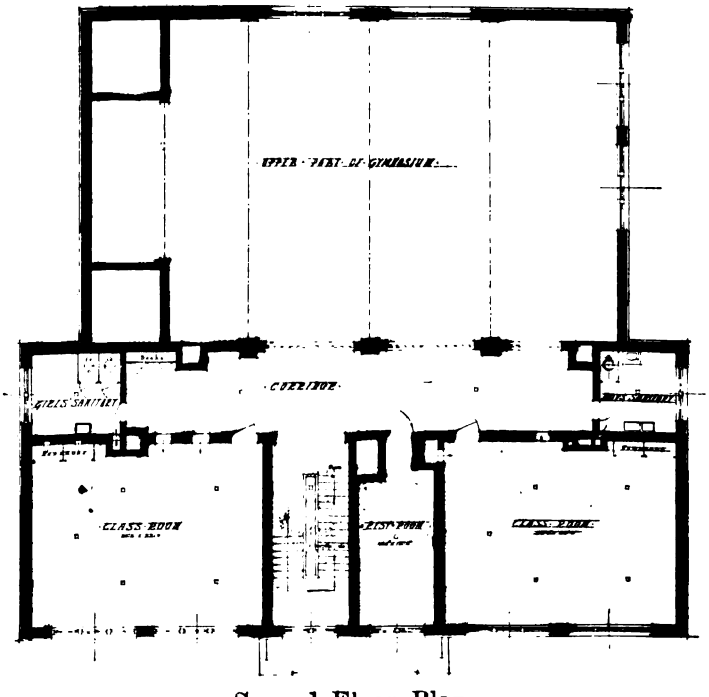
First Floor Plan



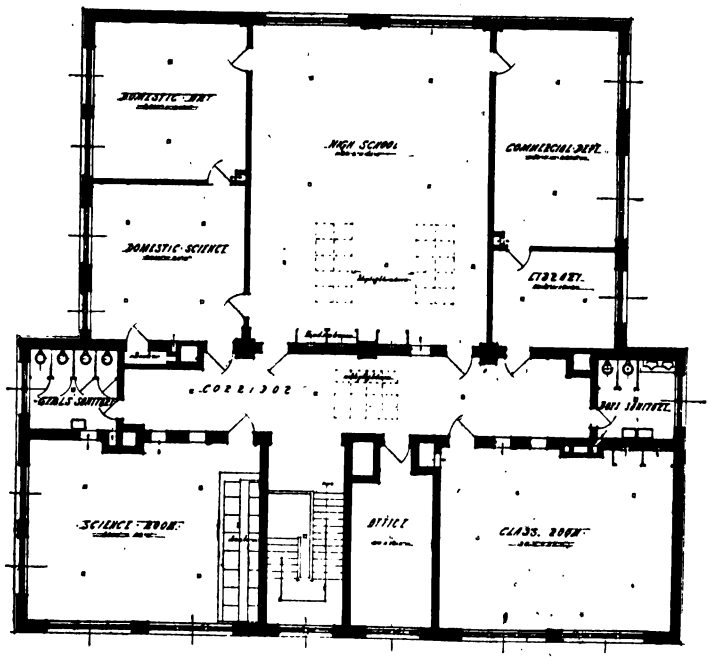
Sand Creek Consolidated School, Lenawee County



First Floor Plan

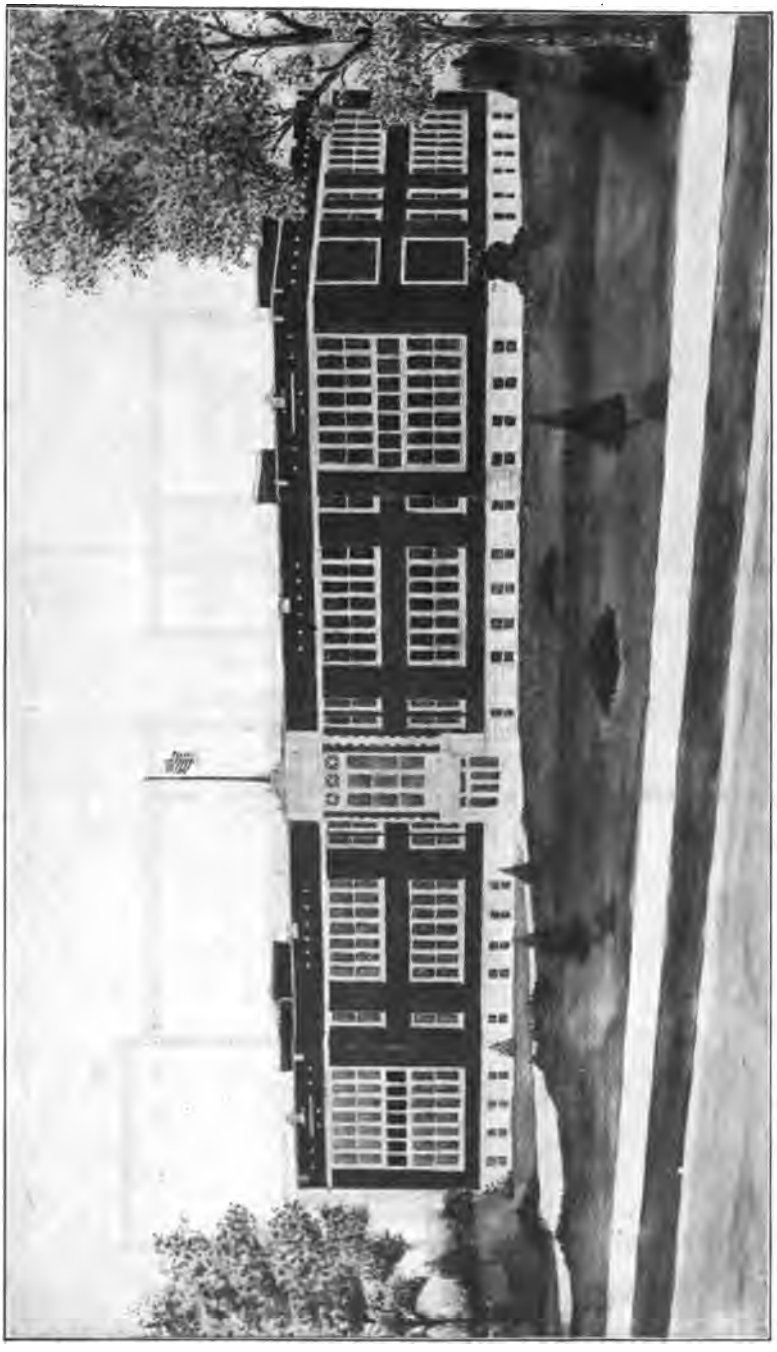


Second Floor Plan

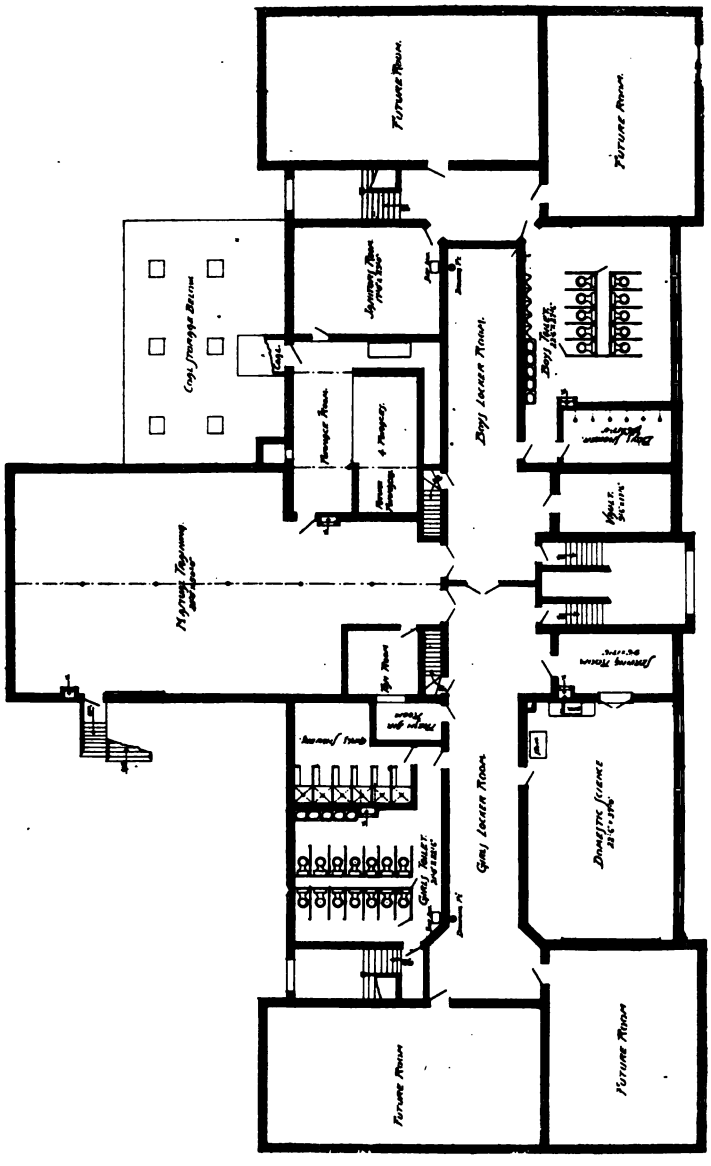


Third Floor Plan

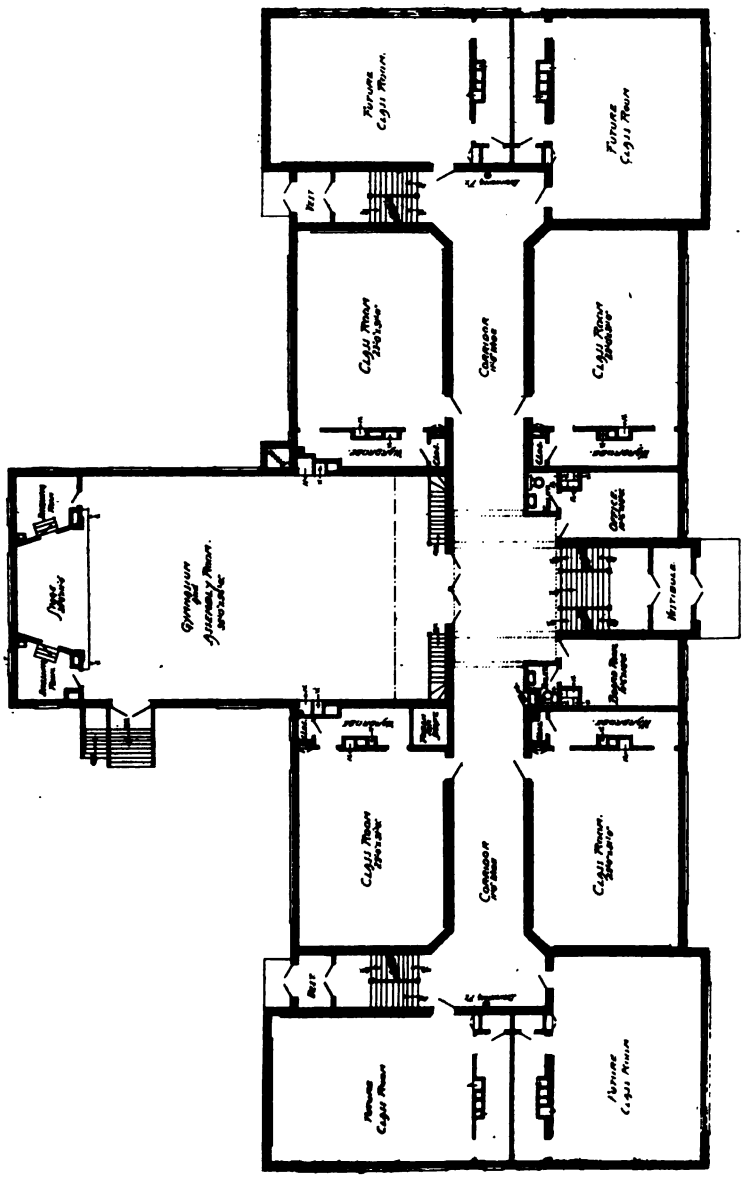
Combination Physics and Chemistry Laboratory, Grand Blanc Consolidated School



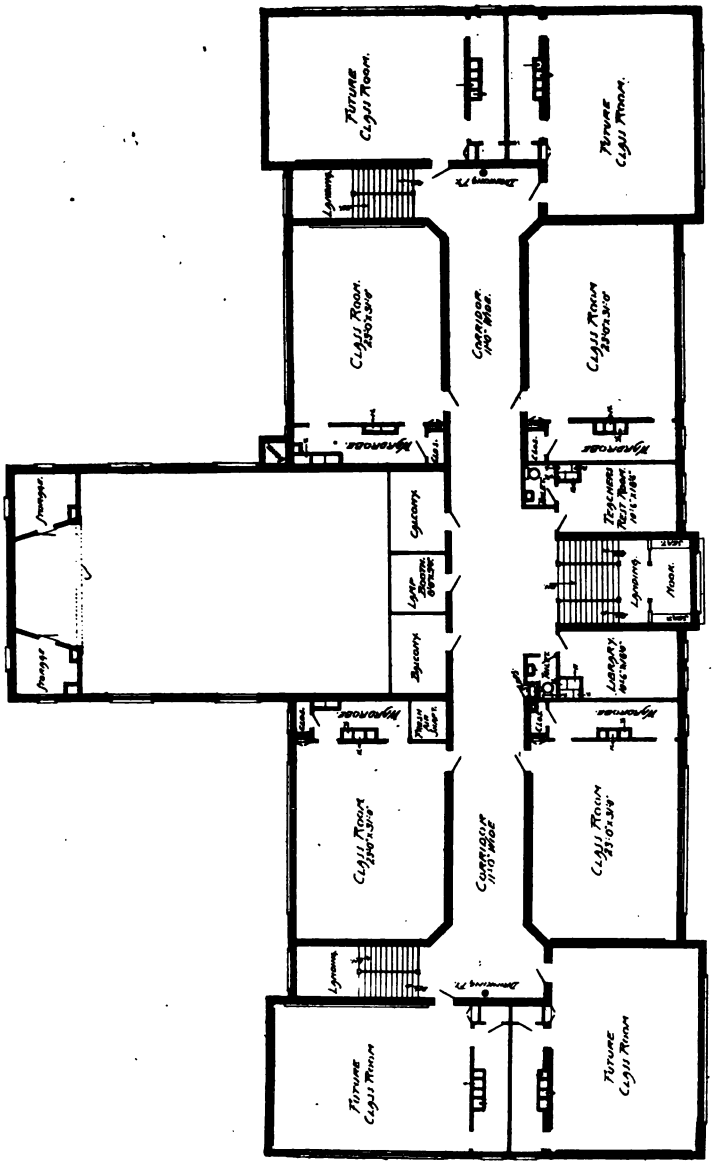
Lakeview Consolidated School, Battle Creek Township, Calhoun County



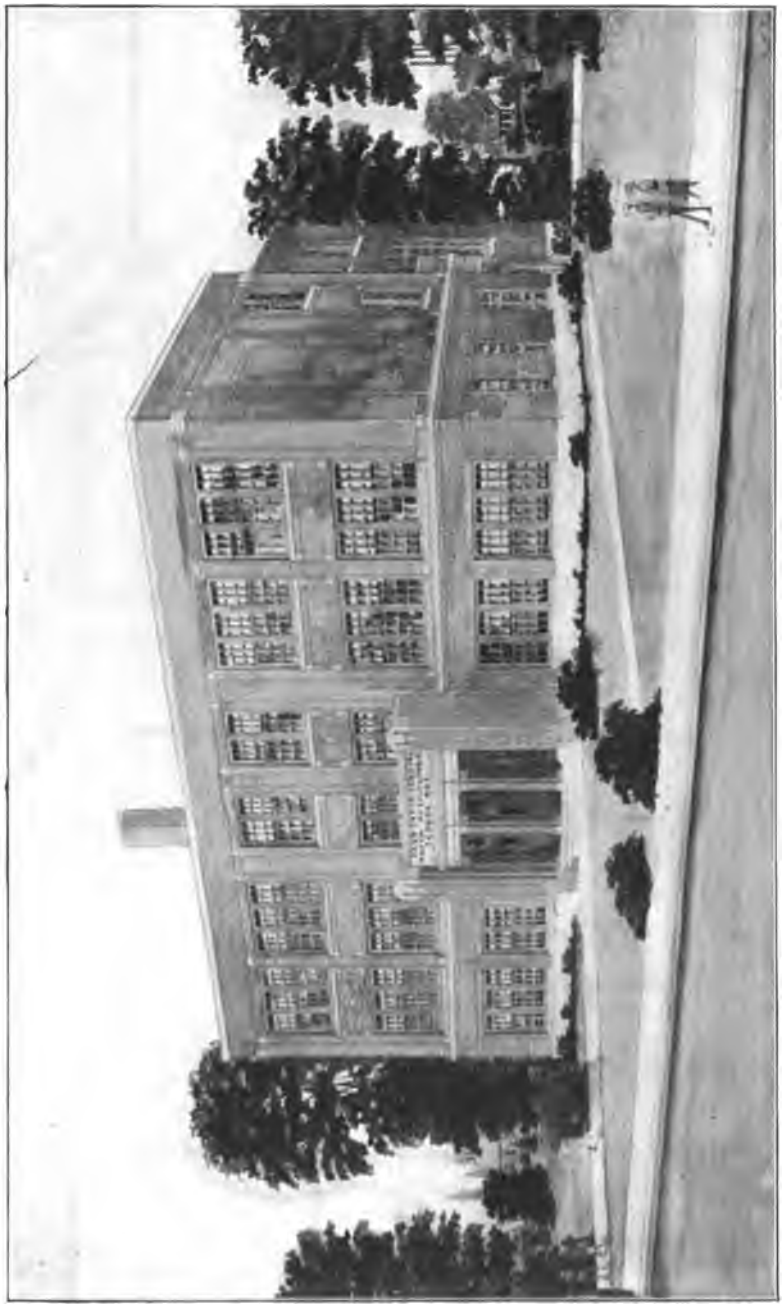
Ground Floor Plan



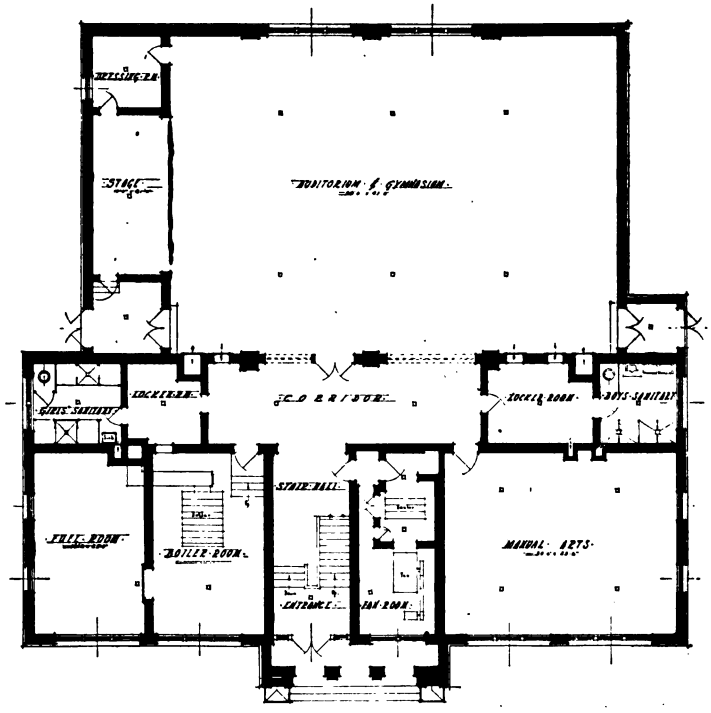
First Floor Plan



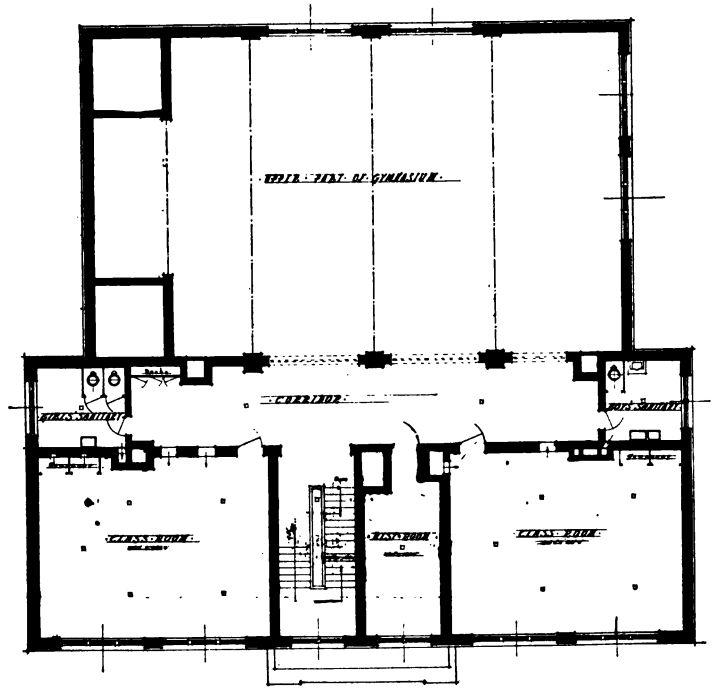
Second Floor Plan



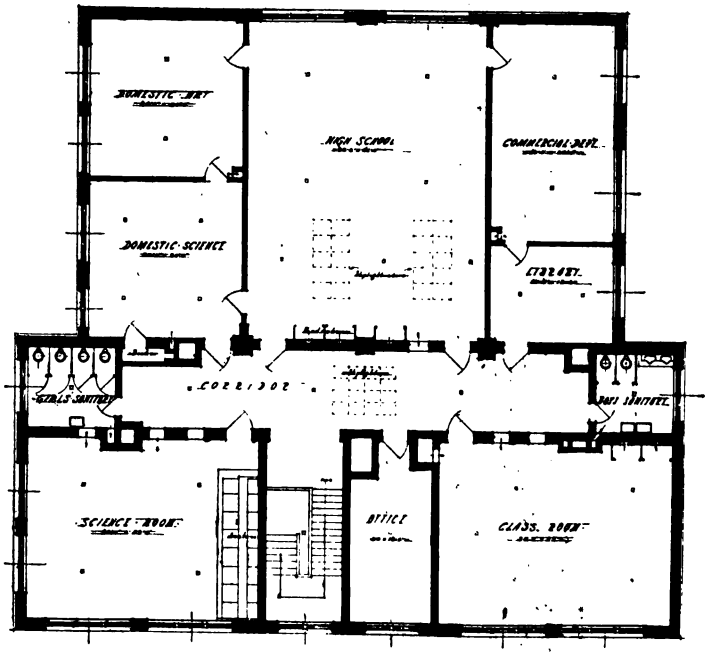
Sand Creek Consolidated School, Lenawee County



First Floor Plan

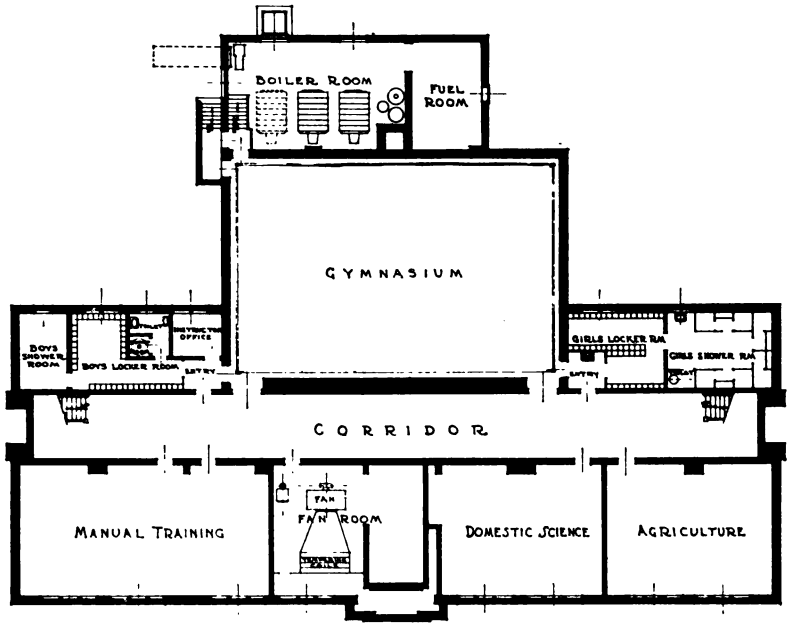


Second Floor Plan

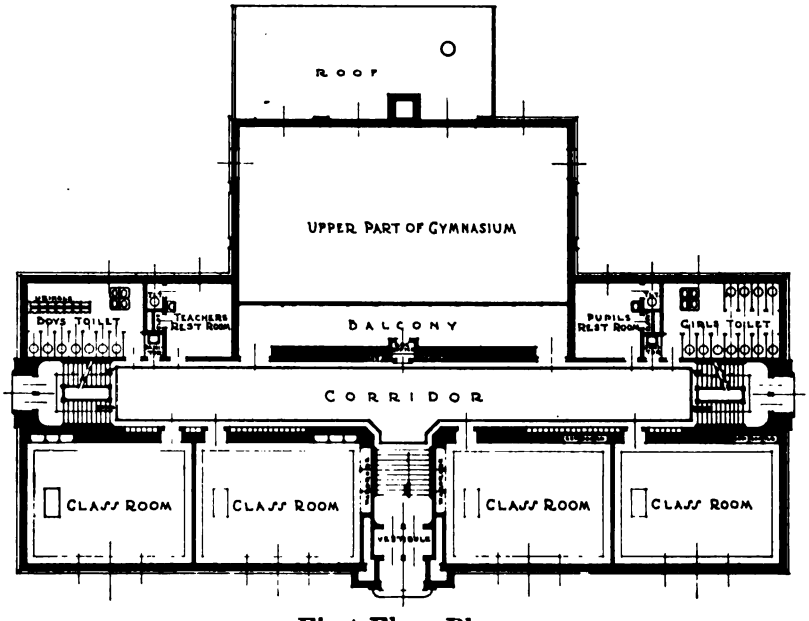


Third Floor Plan

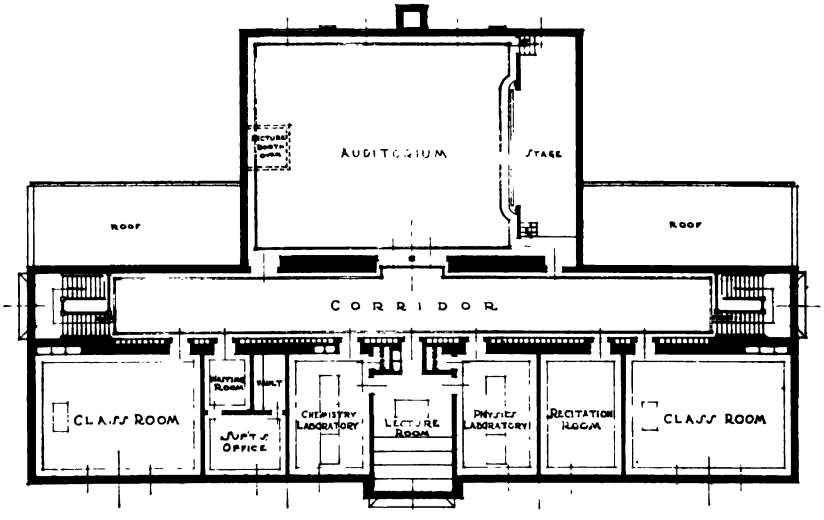
Walled Lake Consolidated School, Oakland County



Ground Floor Plan



First Floor Plan



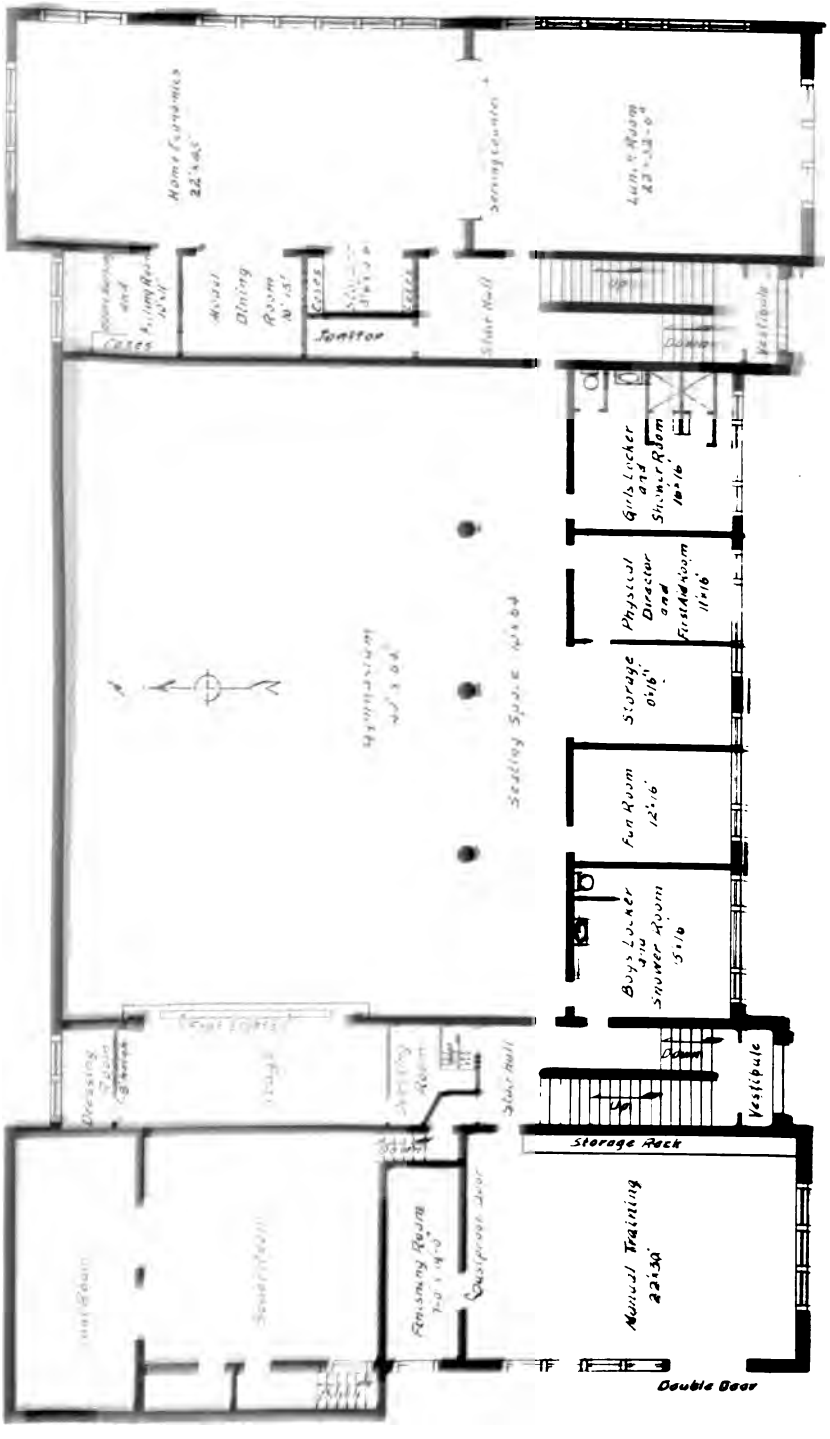
Second Floor Plan

High School Room, Walled Lake Consolidated School

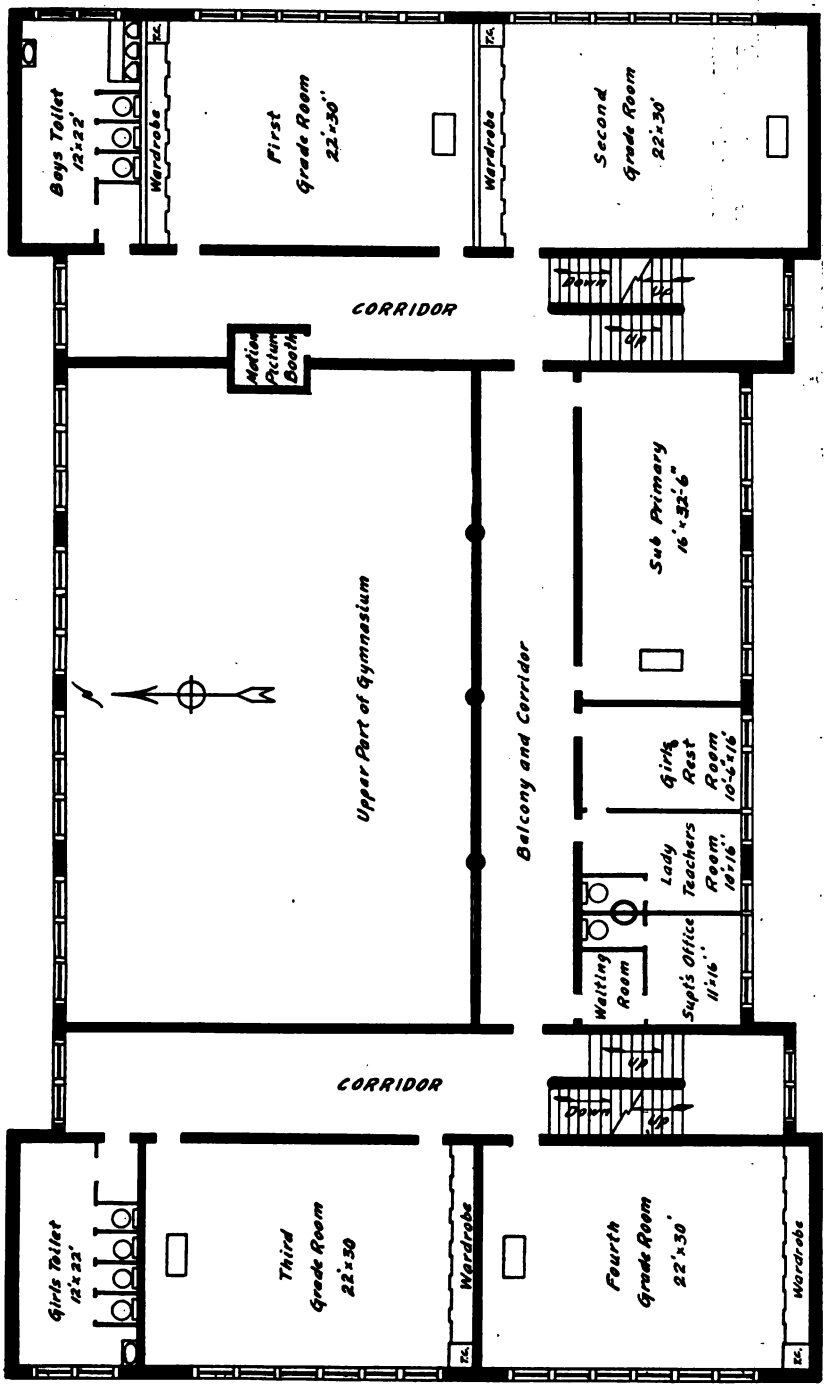
Gymnasium, Walled Lake Consolidated School

A DESIRABLE TYPE BUILDING FOR A CONSOLIDATED SCHOOL DISTRICT OR A SMALL GRADED DISTRICT

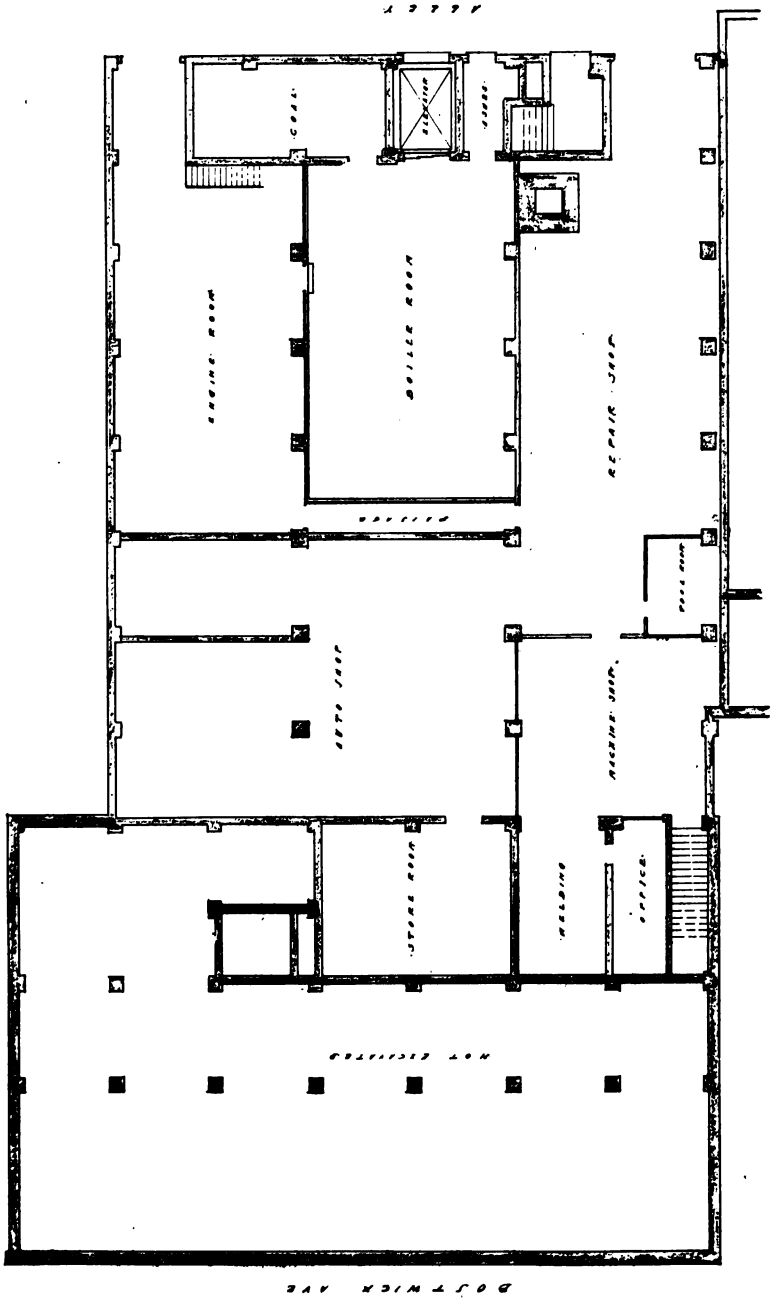
The three following floor plans illustrate a good type of building for a consolidated school or a small graded school where the school population does not exceed five hundred. These plans have provisions for a gymnasium and auditorium combined. The grade rooms are arranged at each end so that they receive light from either the east or the west. Provision is made for the special school activities such as agriculture, manual training, and home economics, and for those other conveniences that are essential for a first class school. The building is so constructed that rooms may be added to care for any future growth. These floor plans are a modification of the plans used for the construction of the school building at Lytton, Iowa.



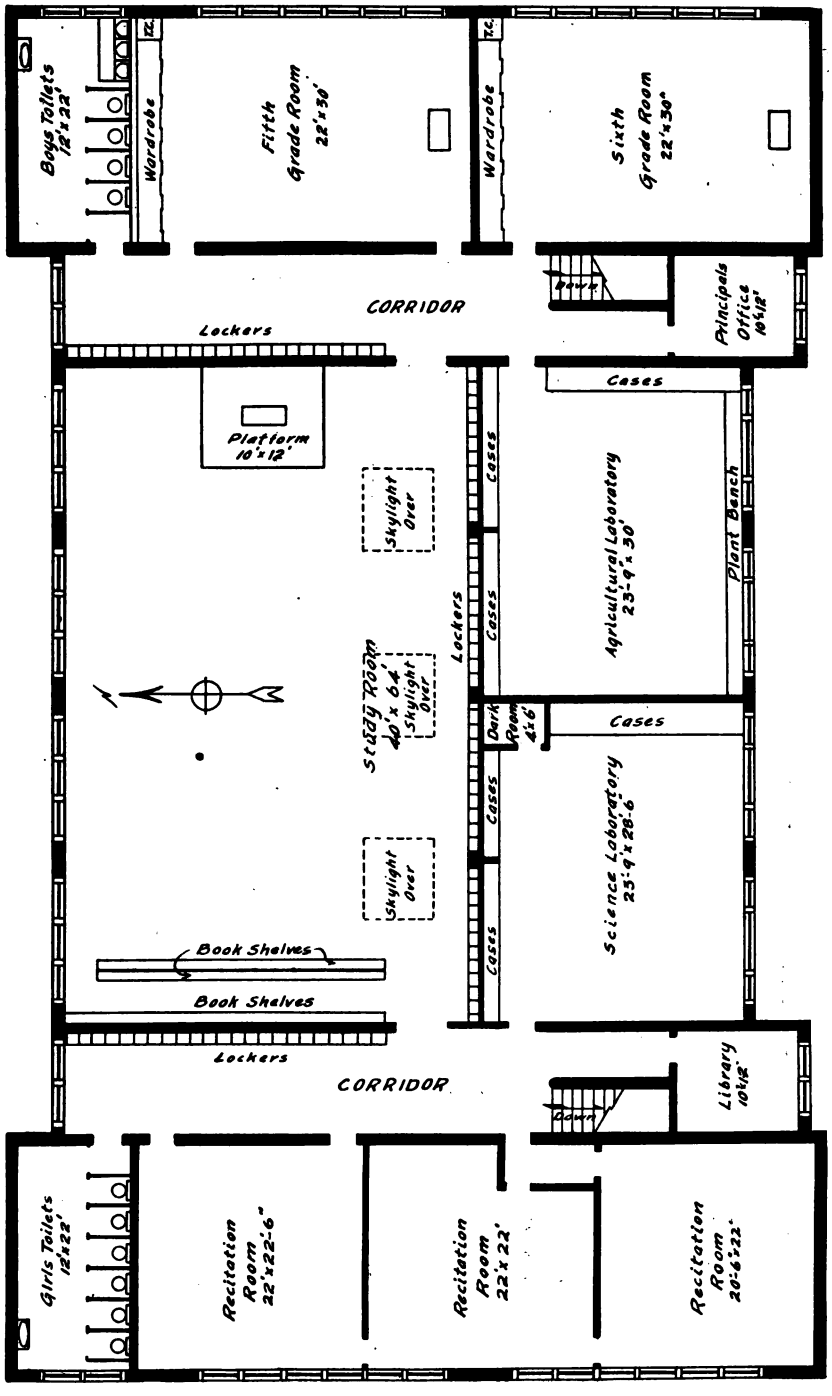
Ground Floor Plan



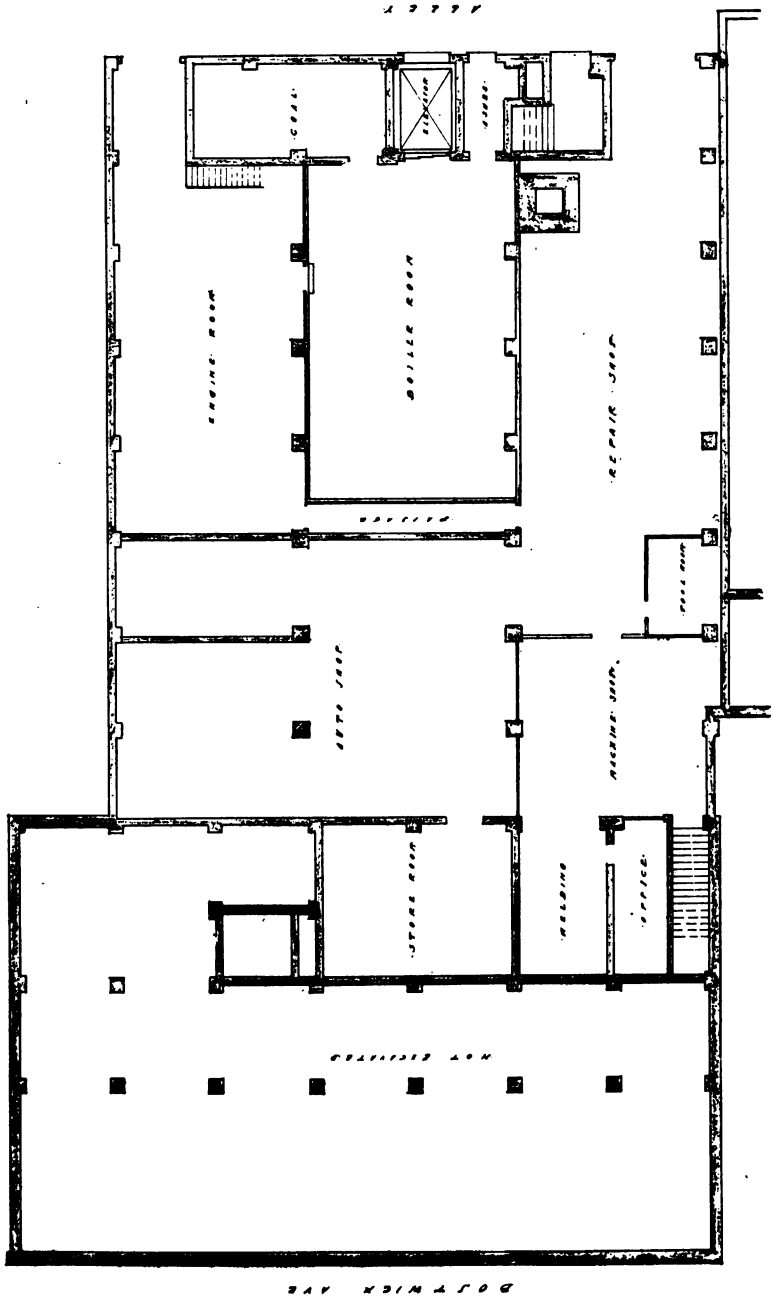
First Floor Plan



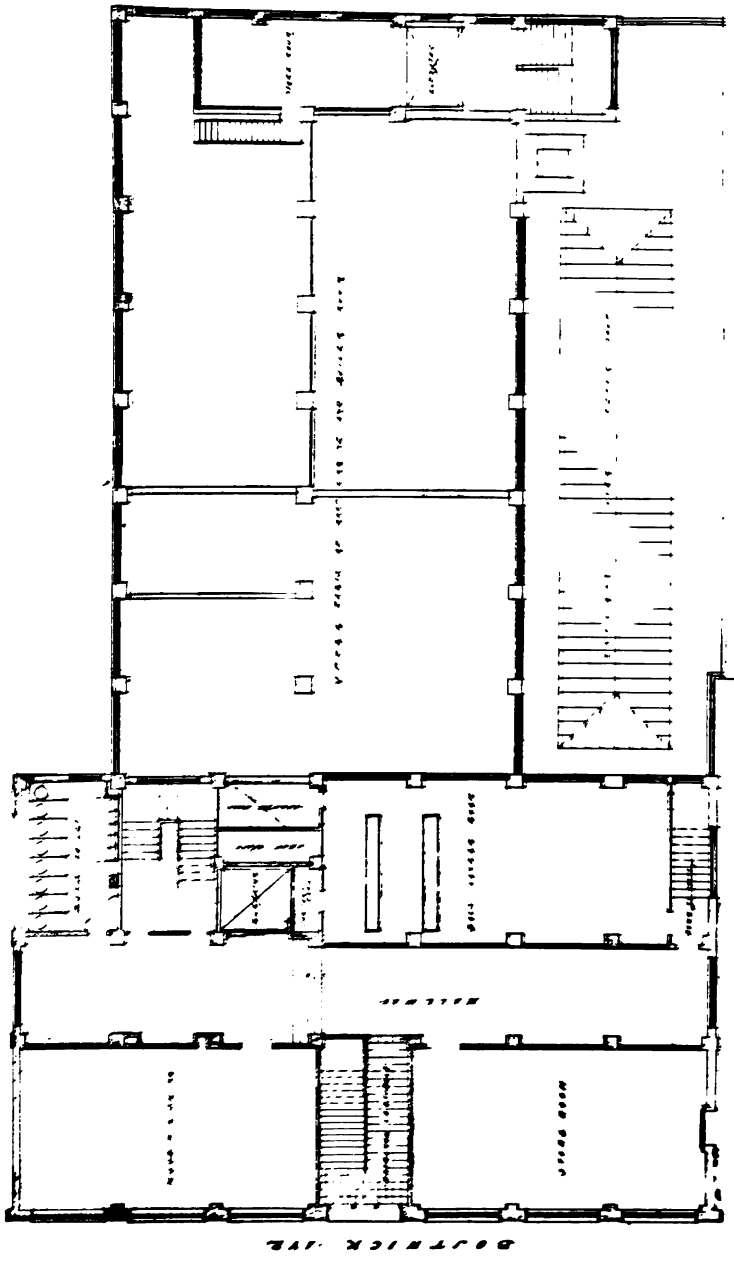
Basement Floor Plan of Vocational School, Grand Rapids



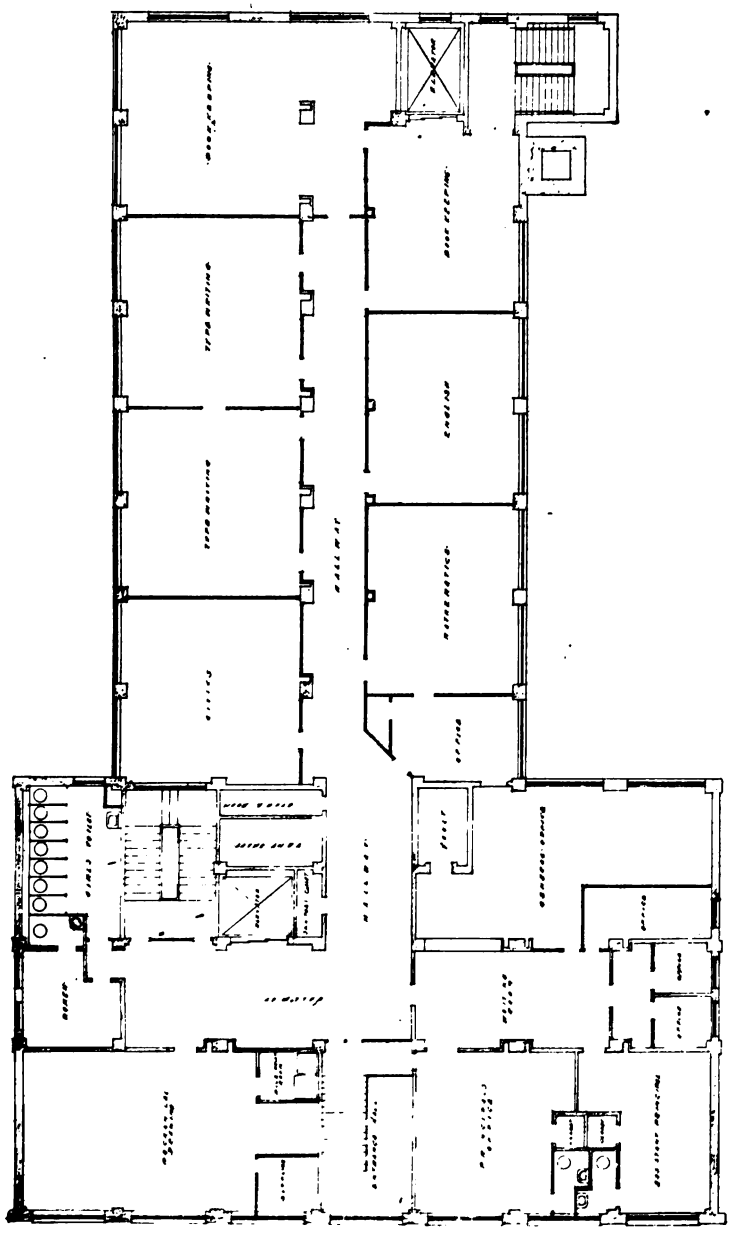
Second Floor Plan



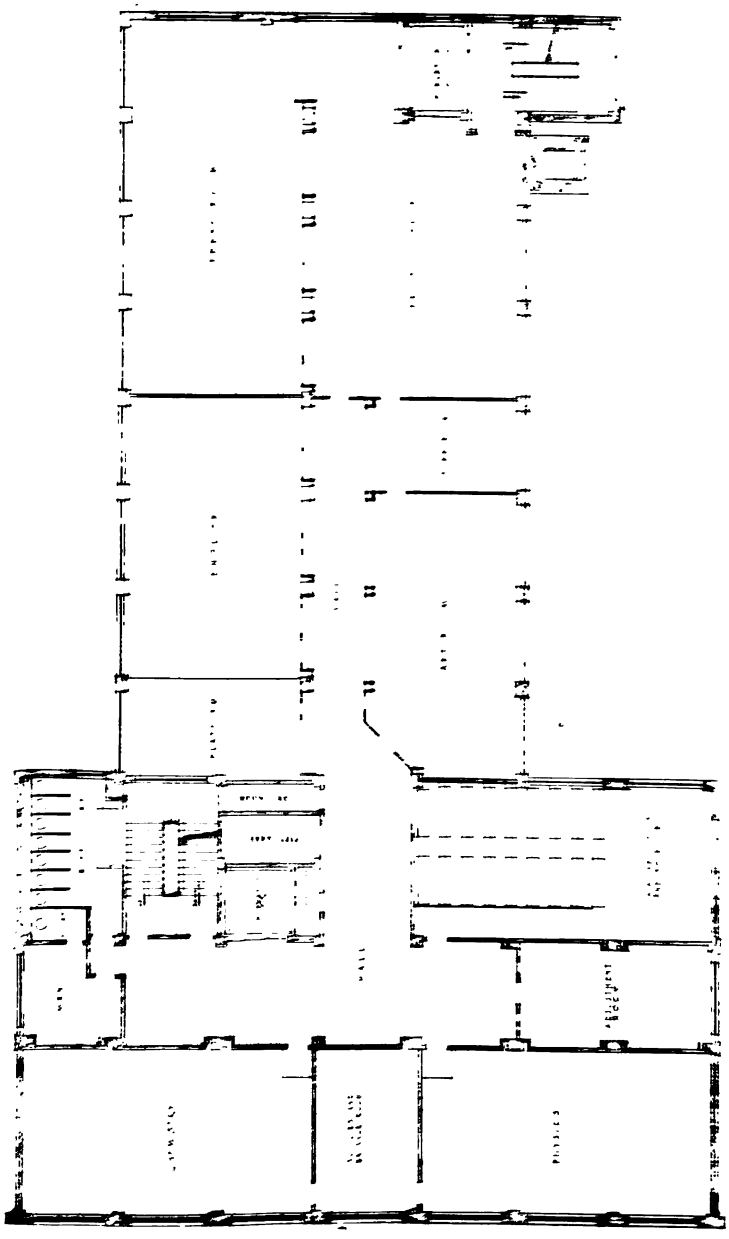
Basement Floor Plan of Vocational School, Grand Rapids



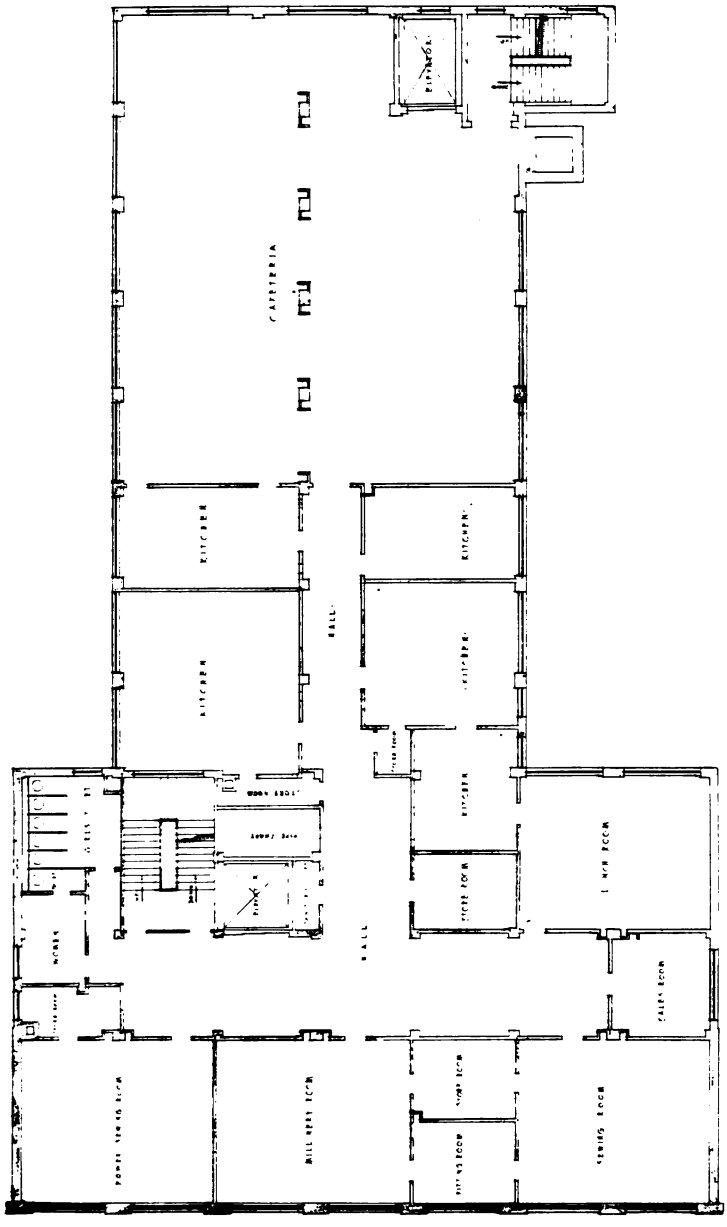
Ground Floor Plan of Vocational School, Grand Rapids



First Floor Plan of Vocational School, Grand Rapids



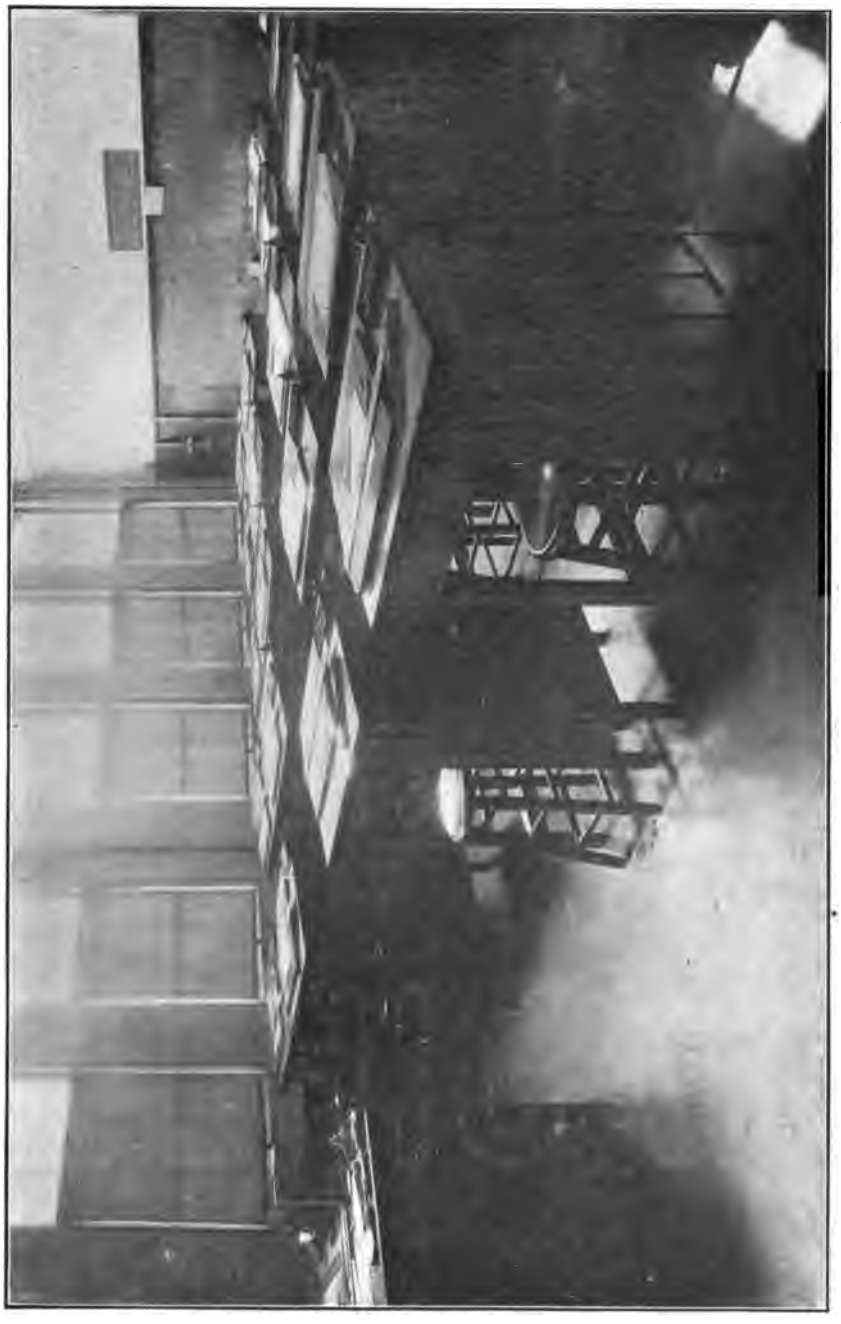
Second Floor Plan of Vocational School, Grand Rapids



Third Floor Plan of Vocational School, Grand Rapids

Domestic Science Room, Muskegon Heights High School

Cafeteria, Benton Harbor High School



Mechanical Drawing Room, Muskegon Heights, High School

Typewriting Room, Muskegon Heights High School

Machine Shop, Muskegon Heights High School

Auto Mechanics, Muskegon Heights High School

Tool Room, Muskegon Heights High School

Printing Department, Muskegon Heights High School

Chemistry Department, Muskegon Heights High School

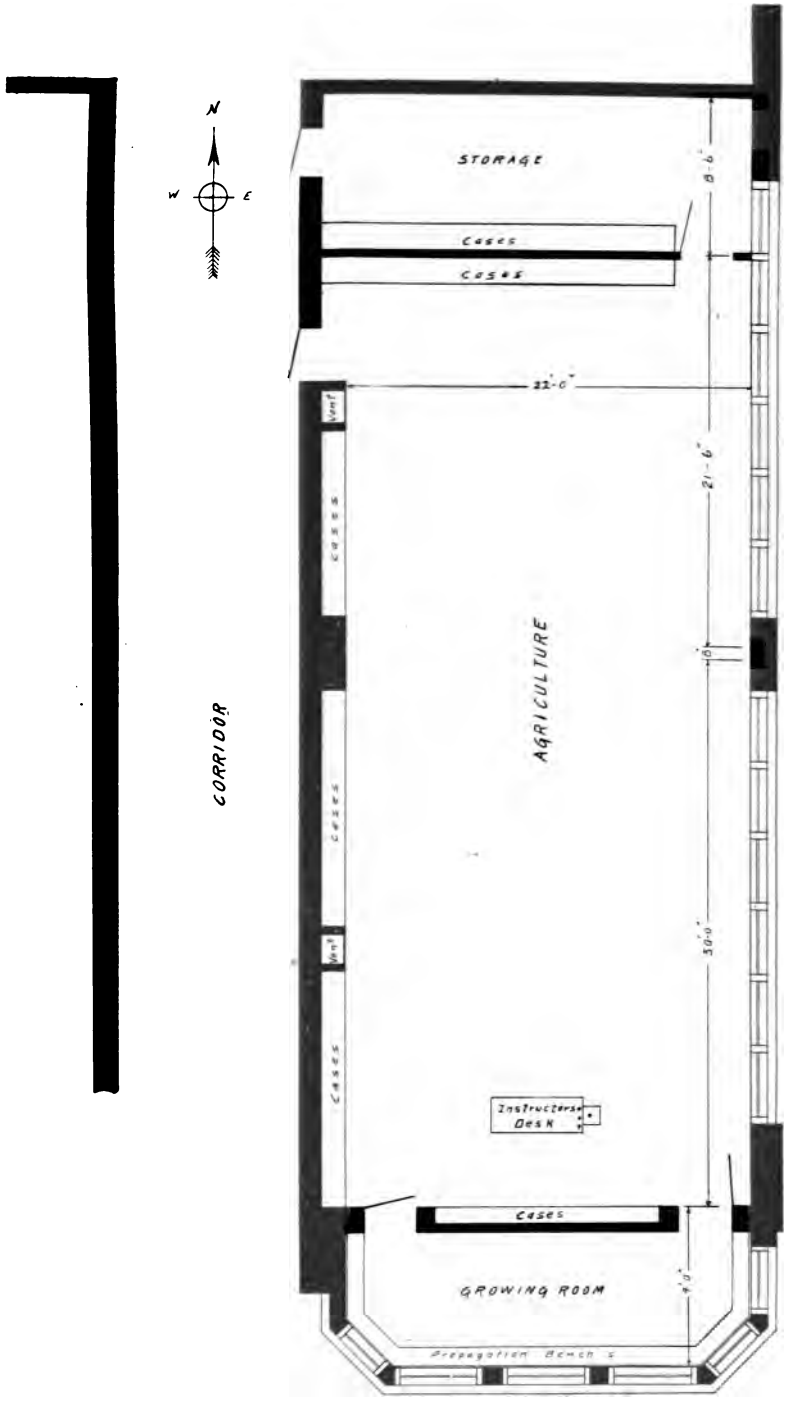
Physics Department, Muskegon Heights High School

Lecture Room for Physics and Chemistry, Muskegon Heights High School

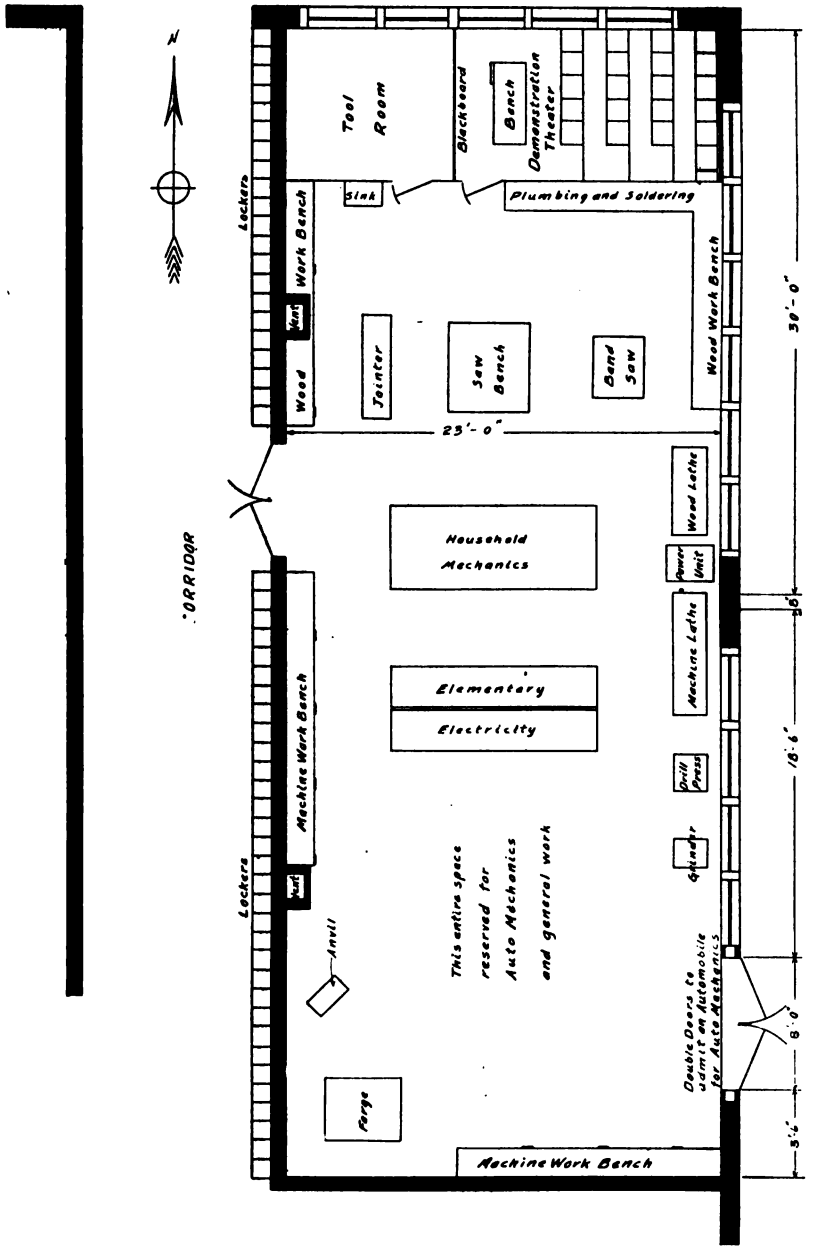
An Agriculture Room

TYPE ROOMS FOR SPECIAL SCHOOL ACTIVITIES

The following type rooms have been carefully worked out for the purpose of aiding architects, Boards of Education, and Superintendents in preparing plans for submission to the Department of Public Instruction for approval. These plans of rooms for special activities will fit into any school construction. The space needed for the various activities has been carefully considered when preparing the plans.

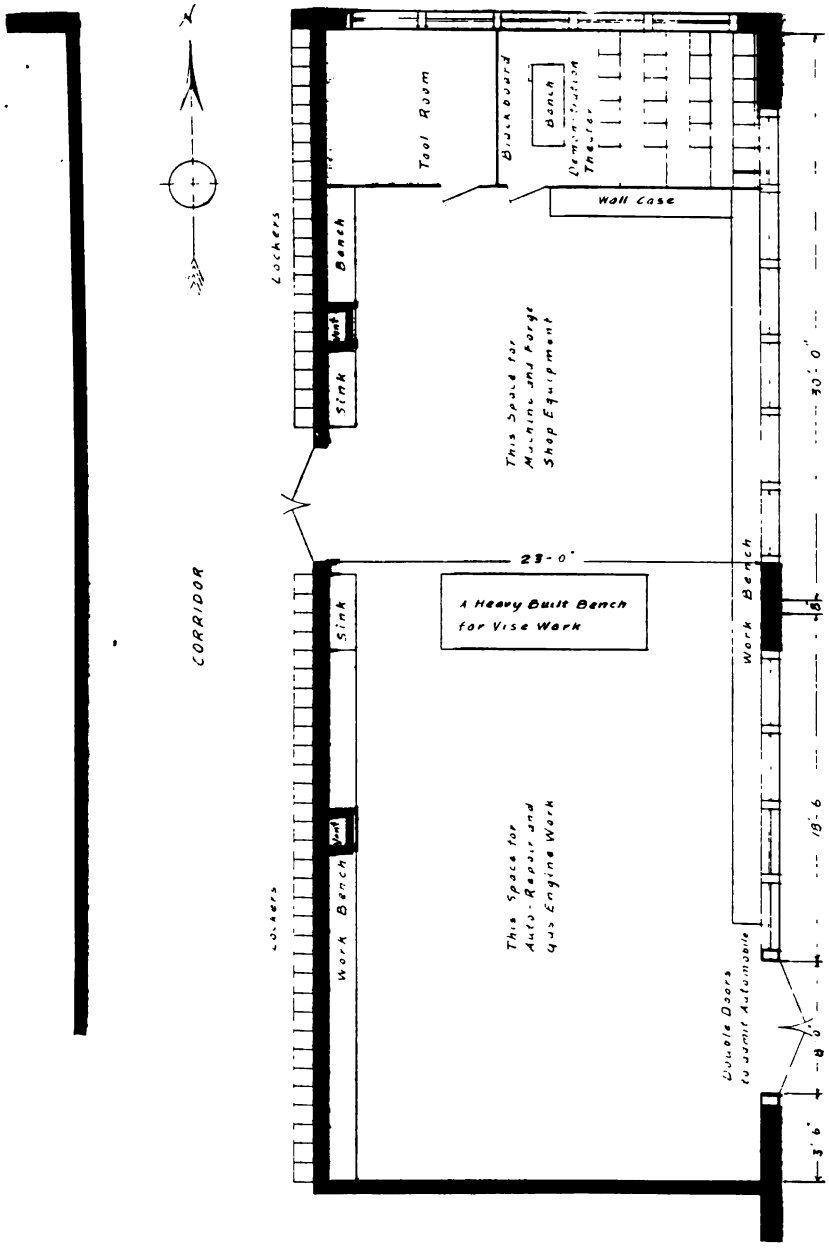


A Desirable Agricultural Department



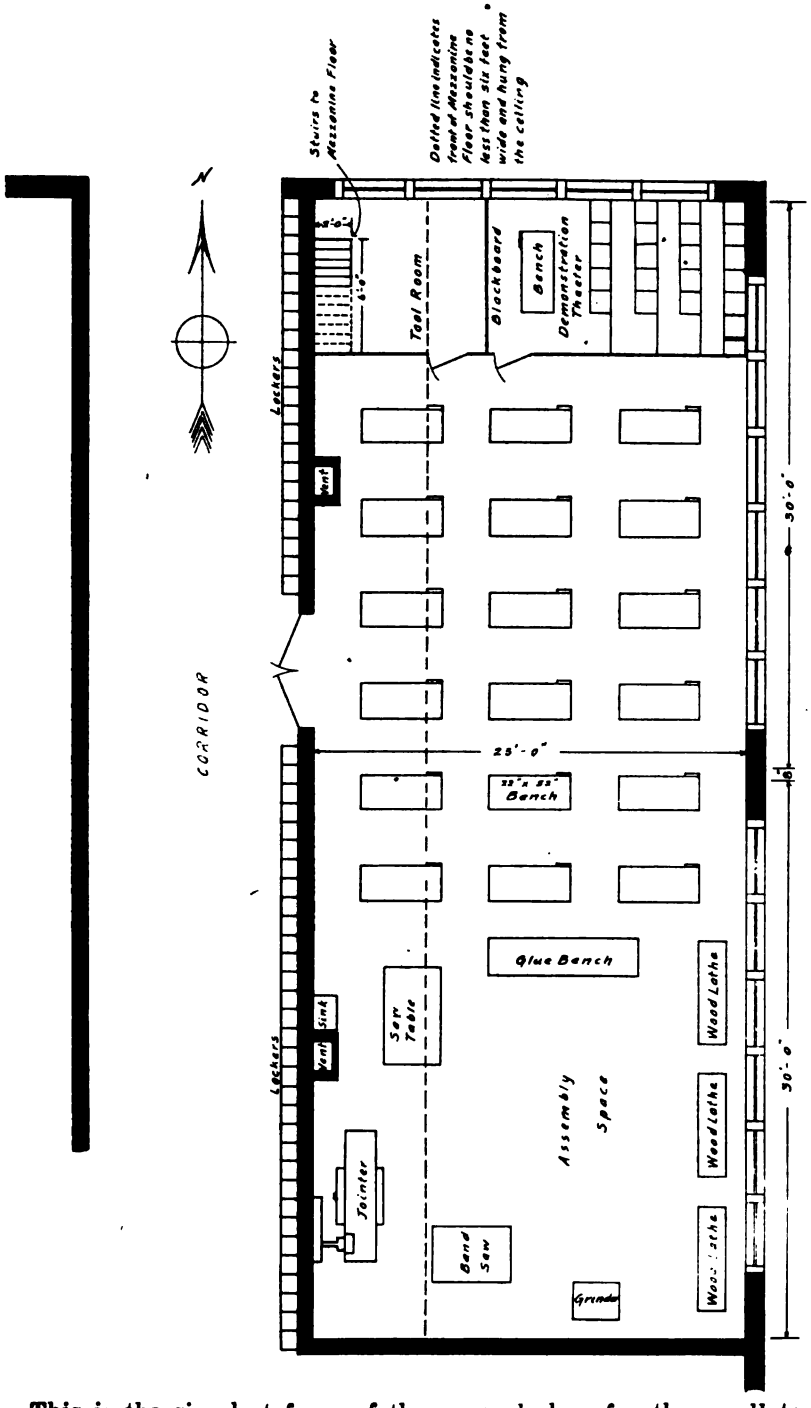
A Complete General Shop for Woodworking, Metal Working, Auto Mechanics, and Household Mechanics

This is a complete modern general shop providing for a general industrial course in woodworking, metal working, auto mechanics, household and farm mechanics, and elementary electricity. Demonstration room may be used as finishing room with storage above.



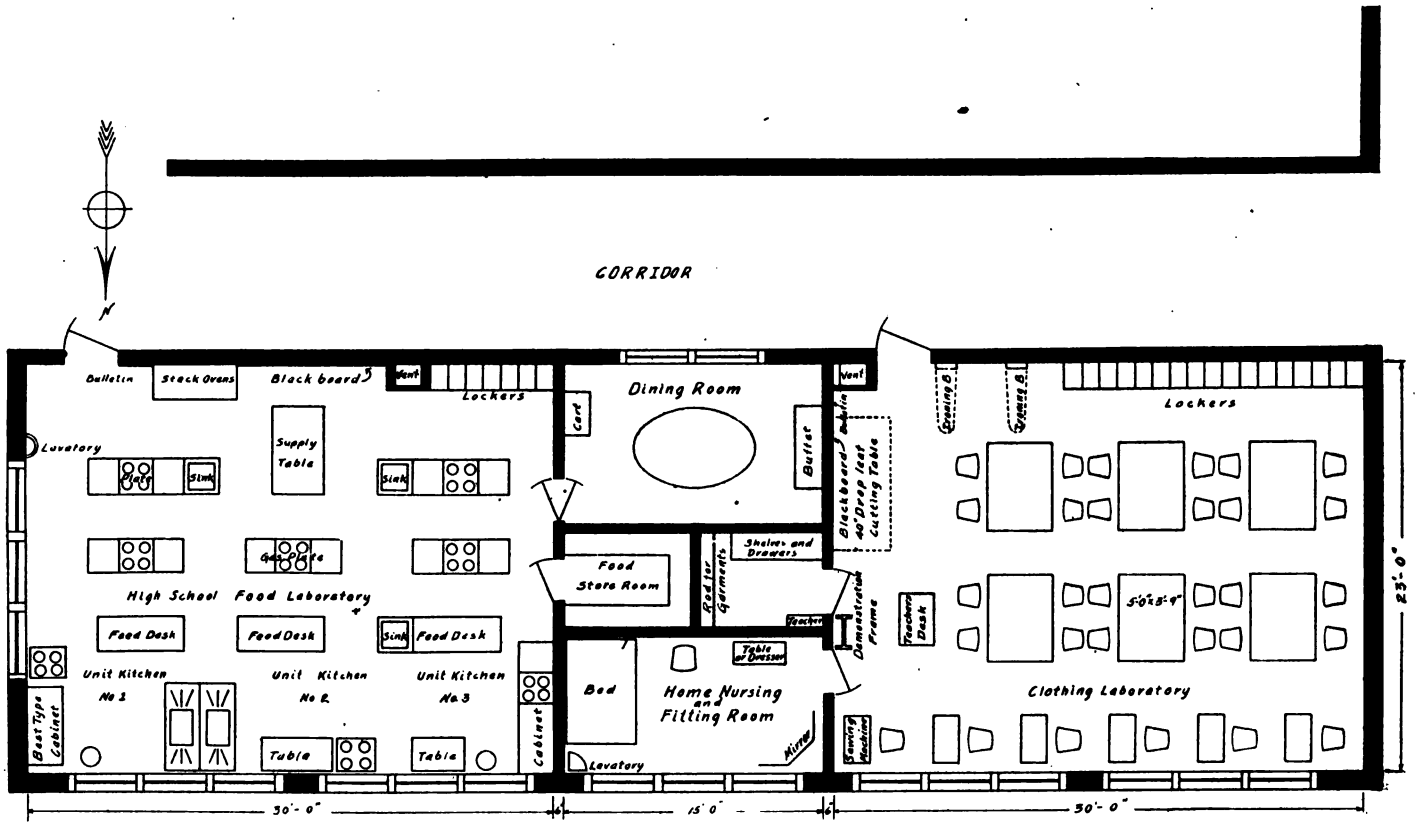
A Standard Auto Mechanics and Machine Shop

This shop presupposes that woodworking is taught in a separate shop. Household and farm mechanics and elementary electricity may be taught in this shop if not provided for in the woodworking shop. This shop should be used chiefly for auto and machine shop work on a prevocational or vocational basis.

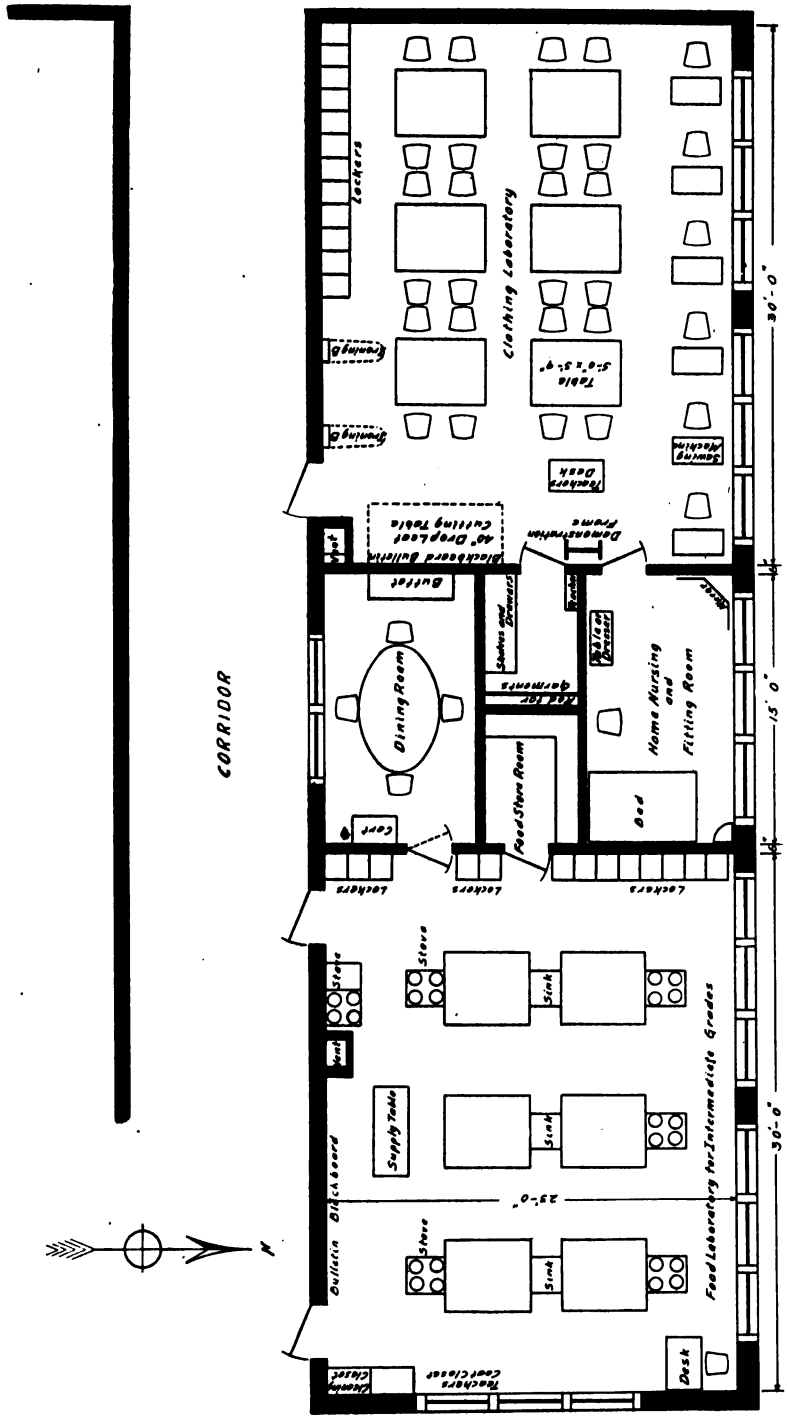


General Shop for Wood Work, Household and Farm Mechanics, and Elementary Electricity

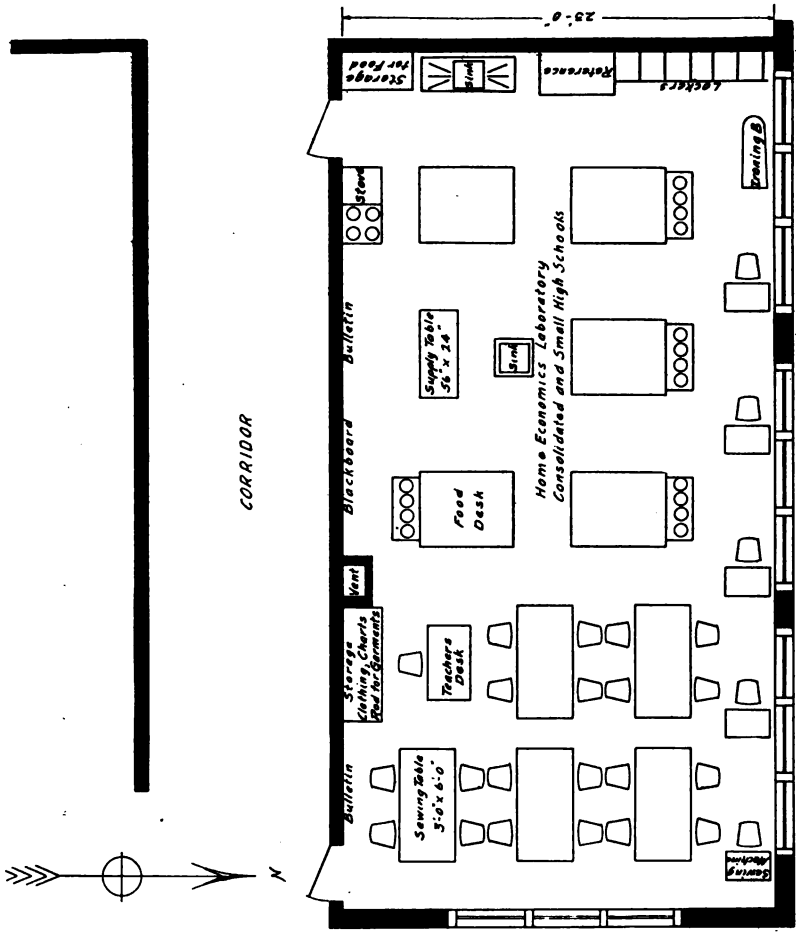
This is the simplest form of the general shop for the small town and the agricultural school. It can be handled by one teacher. Household and farm mechanics and elementary electricity should be a part of the course. This shop does not provide for metal working. Demonstration room should be a finishing room unless such a room is provided. Lumber storage may be above finishing room and tool room.



Home Economics Department for a Senior High School or the Large Four Grade High School



Home Economics Department for Junior High Schools



Home Economics Department for Rural Agricultural Schools and Small Graded Schools

HOME ECONOMICS FURNITURE AND EQUIPMENT FOR LARGE HIGH SCHOOLS

A. FOOD LABORATORY

1. Modified Unit Kitchen Plan

See Cooking Laboratory, page 38

2. General Furniture and Equipment

Stoves with one burner and oven space for each pupil
Supply table
A laboratory desk for each pupil with drawer for small equipment and cupboard for utensils, allowing at least 20 inches by 30 inches work space for each pupil
A stool for each pupil. It may be attached to laboratory desk.
Instructor's desk and chair
File for bulletins and clippings
2 lavatory basins
1 sink for each four girls
1 blackboard
1 bulletin board
Lockers for cooking uniforms
1 refrigerator

3. Dining Room Furniture and Equipment

1 buffet or built in china cupboard for china, silver, and linen
1 dining table
6 chairs
1 tea cart or serving table
Rug
Curtains

4. Laundry Equipment

1 pair double stationary tubs
2 tubs
2 ironing boards
2 electric irons with stands
Washboard
Electric washer
Wringer
1 cork bulletin board

Wall lockers for pupils' personal use
Blackboards
1 bookcase for reference books and bulletins
Dryer
1 washing machine (may be borrowed from dealer)
Gas plate
Tea kettle

5. Bedroom Furniture and Equipment

1 single bed with mattress
1 dresser or chest of drawers with mirror
2 chairs; one may be a rocker
1 small table
1 small lamp
1 waste basket
1 rug
Curtains

6. Bath Equipment

1 tub
1 mirror on door
1 towel rack
1 toilet
1 lavatory
1 medicine chest
1 towel rod

7. Living Room Furniture and Equipment

1 table
1 lounge, davenport, or settee
2 chairs, one a rocker
1 bookcase or shelving
Additional furnishings to serve other purposes of the room and give home-like appearance, as desk, rug, curtains, pottery, lamp, and pictures

8. Storage for Food Laboratory

Cupboards and shelving for food, utensils, towels, and dishes
Laundry closet
Cleaning closet for broom, mops, and other cleaning equipment
Closet with adjustable shelves and rod for lessons in bedding storage and care of clothes

9. General Equipment for Food Laboratory

(a) General Equipment

1 towel rack; either one large rack or individual racks
1 hand towel rack with paper towels
1 covered garbage pail
1 waste basket
1 broom
1 mop
1 dust pan
1 metal flour can, 48 pounds capacity, if not included in supply table
1 flour sifter
1 tin or stone container for sugar
6 dozen sanitary dish clothes for dish washing
6 dozen dish towels for drying dishes
1 scale, family size, 24 pounds capacity
2 water pitchers, two quarts each
6 potato mashers of two types
4 potato ricers
2 bread knives
2 butcher knives
1 knife sharpener
4 long-handled forks
2 long-handled skimmers or slit spoons
4 quart measures
4 lemon squeezers
2 can openers and corkscrews
2 graters, rotary preferred
1 food chopper
1 colander for each sink and one extra
4 tea pots
4 coffee pots
1 percolator
1 or 2 tea balls
2 funnels, different sizes
2 ice picks
1 nut cracker
4 cake coolers
4 large pyrex baking dishes
Cookie cutters
6 bowls 8 inches in diameter
6 bowls, 11 inches in diameter
1 large preserving kettle

1 wire rack for preserving kettle
½ dozen pint fruit jars
½ dozen quart fruit jars
½ dozen ½ pint fruit jars
1 dozen jelly glasses
2 double boilers, 2 quart size
2 large sauce pans with lids
1 large iron skillet
1 large tea kettle
2 round dippers, enamel or aluminum
6 trays, nickel plated, aluminum or japanned, 1 small
1 roaster, Russian sheet iron, enamel or aluminum
8 one-quart ice cream freezers

Note: Girls furnish aprons. School furnishes all groceries, meats, milk, and gas.

(b) Dining Room Equipment

2 table cloths
1 dozen dinner napkins
1 dozen luncheon napkins
6 tray doilies
1 bowl for flowers
6 knives
6 butter spreaders
6 forks
6 salad forks
6 tablespoons
6 soup spoons
10 teaspoons
12 thin, plain glasses
2 pairs salt and pepper shakers
1 water pitcher or jug
6 soup bowls or cream soup cups
12 breakfast plates
12 luncheon or small dinner plates
12 salad plates
6 bread and butter plates
1 cream and sugar
1 chop plate or 12 inch platter
1 large platter
2 vegetable dishes
6 cups and saucers

Note: Simple, plain china is recommended.

(c) Laundry Equipment

Soap chips
Bluing
Starch
Washing soda
Beeswax
Ammonia and other materials for spot cleaning and satin removing

(d) Bedroom Equipment

2 pillows
4 sheets
4 pillow cases
1 mattress pad
Pair each of cotton and woolen blankets
1 bed spread

(e) Bath Room Equipment

First aid supplies
Bath and hand towels
Bath mat

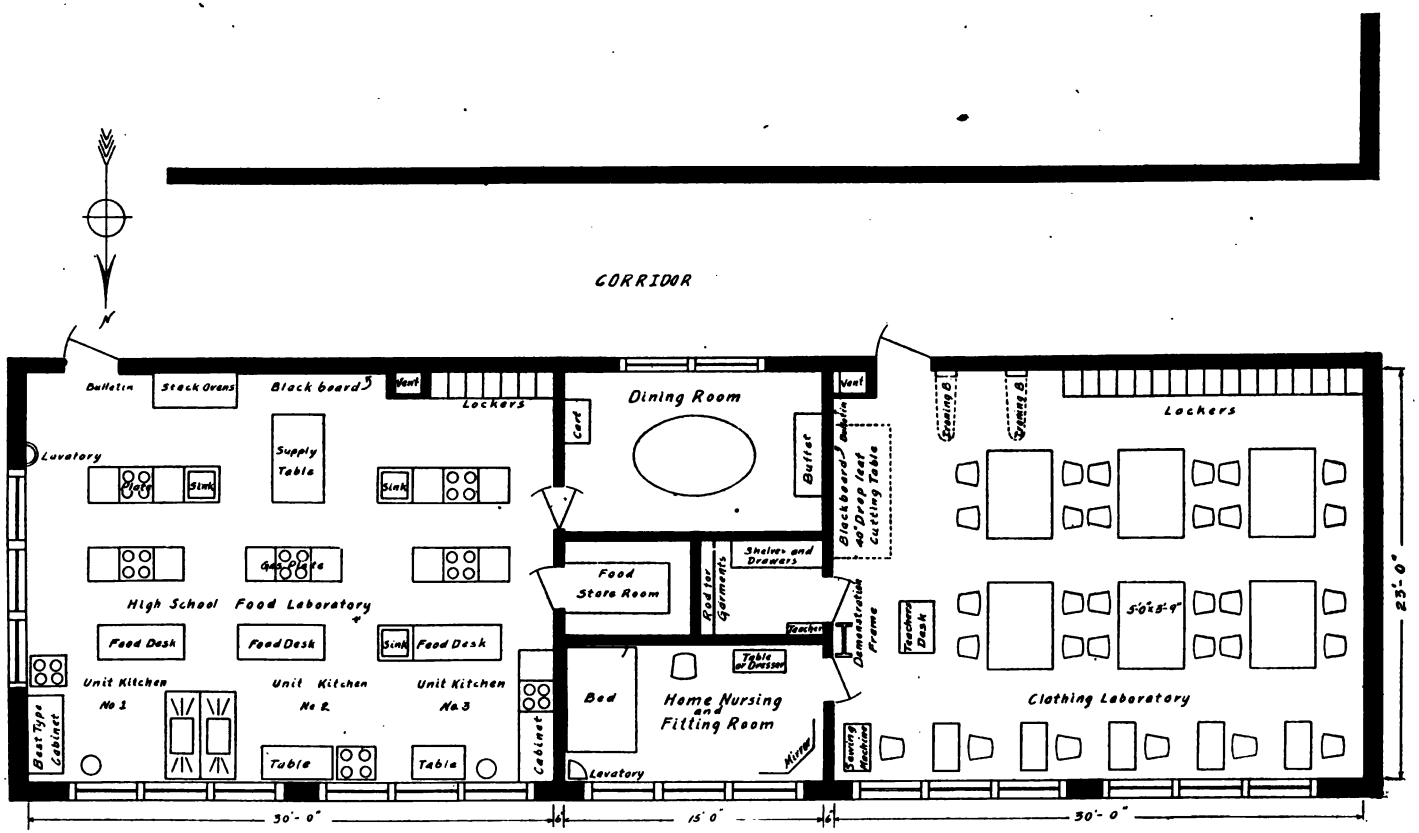
10. Individual Equipment

(a) Equipment for Each Pupil

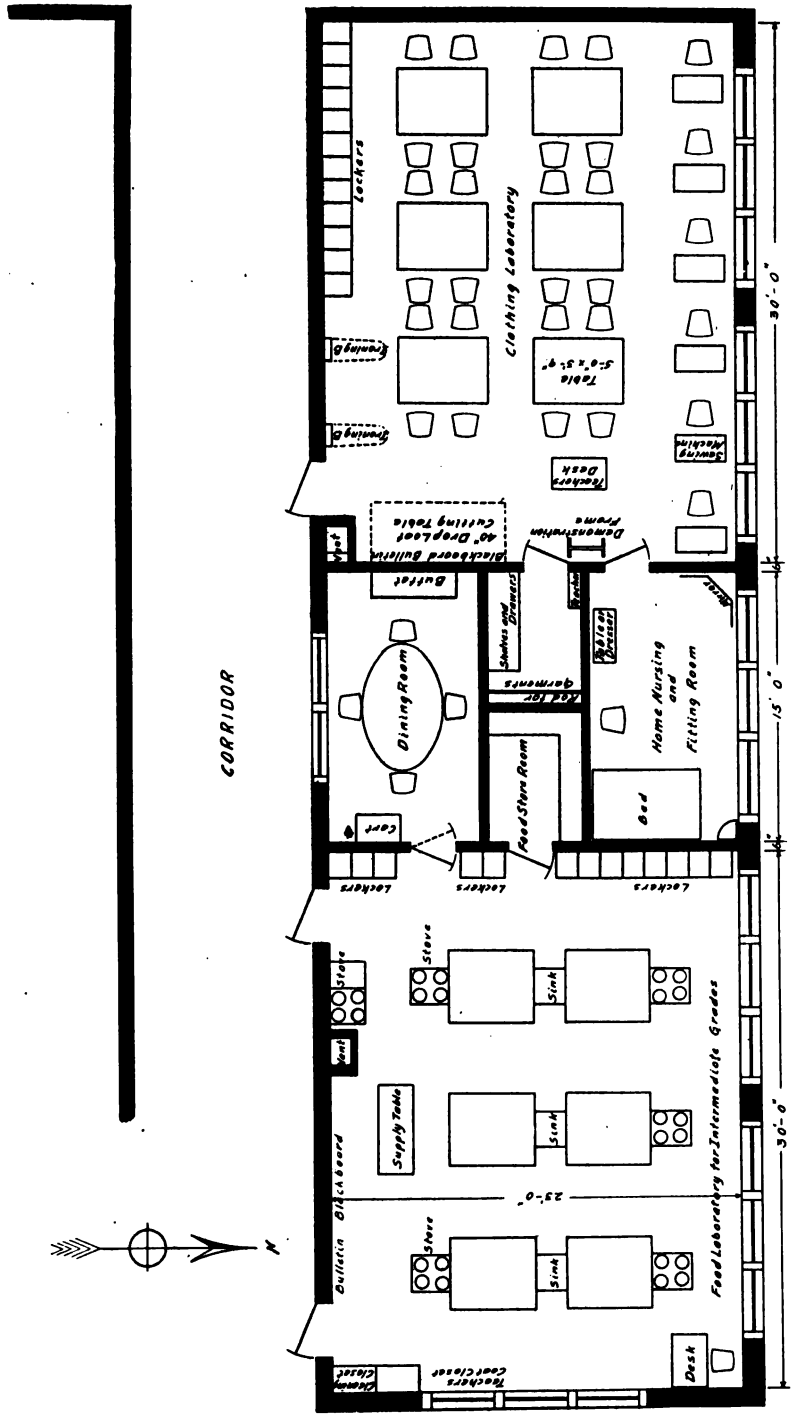
1 asbestos mat
1 good steel paring knife
1 enamel or earthen or pyrex custard cup
1 fine mesh wire sieve strainer, 6 inches in diameter
1 dish pan and dish drainer for each two students
1 tin bread pan, ½ pound loaf
1 small china bowl, three or four cup capacity, or approximately 6 inches in diameter
1 mixing bowl 9 inches, enamel or earthen
Plates, plain white, 7 inch
1 cup and saucer
Aluminum teaspoons
1 fork
1 plated knife, fork, and teaspoon
½ pint glass measuring cup
½ pint tin or aluminum measuring cup

(b) Equipment for Every Two Pupils

1 spatula
1 muffin pan, 6 or 8 holes



Home Economics Department for a Senior High School or the Large Four Grade High School



Home Economics Department for Junior High Schools

HOME ECONOMICS EQUIPMENT FOR RURAL AGRICULTURAL SCHOOLS

[illegible] FURNITURE AND EQUIPMENT FOR FOOD LABORATORY

[illegible] Equipment

[illegible] space for food packages, perishable, etc.
[illegible] boards for general utensils, dishes, groom, etc.
[illegible] most practical and suitable for school. Allow the proper
or pupil and [illegible] space sufficient for [illegible] pound bread pan space per
pupil
[illegible]
[illegible] tables may also be used as dining tables)
[illegible] for pupils
[illegible] work space of at least 20 inches x 30 inches per pupil, drawer
[illegible] inches deep for small equipment, and cupboard space for utensils
[illegible] for each group
[illegible] work—either one large sink for individual desks
[illegible] and towel holder with paper towels
[illegible]
garbage pail—covered
waste basket
broom
pan
mat pan
metal dipper pan (8 pounds capacity if not required in supply table
may be same container for sugar
frozen sanitary fish cloths or dish washing
frozen dish towels for drying dishes. These may be hemmed flour sacks
[illegible] family size, 24 pounds capacity
fork fiber
water pitcher [illegible] glasses
potato masher
[illegible] kitchen knives
[illegible] handled fork
[illegible] measure
[illegible] squeezer
[illegible] opener and corkscrew
strainer
[illegible] cooper
[illegible] for the sink and one extra
[illegible] pot

1 coffee pot
6 bowls, approximately 8 inches in diameter
6 bowls, approximately 11 inches in diameter
1 double boiler, 2 quart size
2 large sauce pans with lids
1 large skillet
1 large tea kettle
1 enamel or aluminum round dipper
1 nickel-plated or aluminum tray
1 bulletin board
Blackboard space
Reference books

Note: Girls furnish aprons. School furnishes all groceries, meat, milk, and gas.

2. Equipment for Each Pupil

Good steel paring knife
Enamel or earthen or pyrex custard cup
Fine mesh wire sieve strainer, 6 inches in diameter
Dish pan and dish drainer for each two students
Tin bread pan, ½ pound loaf
Small china bowls, 3 or 4 cup capacity or approximately 6 inches in diameter
Mixing bowl, 9 inches, enamel or earthen
Plate, plain white, 7 inch
Cup and saucer
Plated or aluminum teaspoon
Plated or aluminum tablespoon
Fork

3. Equipment for Every Two Pupils

Spatula
½ pint glass measuring cup
½ pint tin or aluminum measuring cup
Muffin pan, 6 or 8 holes
Pie tin
Layer cake tin
Biscuit cutter
Double boiler, 1 quart, enamel or aluminum
Frying pan, small size

4. Equipment for Every Four Pupils

Tea kettle, if hot water is not always on tap
Pepper shaker
Salt shaker or covered glass jar

Dover egg beater or similar
Egg whip or similar
Vegetable brush
Scrub brush

B. MINIMUM LIST OF FURNITURE AND EQUIPMENT FOR CLOTHING LABORATORY

General Equipment

Tables, at least 36 inches wide, and 28 to 31 inches high. Allow at least 5 square feet per pupil. Four tables 45x60 and 30 inches high sufficient
Chairs, comfortable and low, with additional chairs for sewing machines
Teacher's desk
Storage space
  Locker space for each pupil
  Filing facilities for clippings
  Space for charts, textiles, and other illustrative material
  Case or closet with rod and hangers for garments
Sewing machines, standard make, allowing one machine for two to four girls
Mirror, full length with hand mirror
Ironing board
Iron, electric preferred
Stand for iron
One paper roll and fixture, paper 28 to 40 inches wide
Blackboard
Folding screen or a fitting room
1 dozen yard sticks
3 tracing wheels
Fashion magazines, preferably fashion quarterlies
Reference books

C. ADDITIONAL EQUIPMENT WHICH IS USEFUL BUT NOT REQUIRED

1. General Equipment for Food

Sink for each six or eight girls
Lavatory basin
Refrigerator
Dining table
China, silver, and linen for meal serving
Dripping pans
Ice cream freezers
Roaster
Lockers for care of aprons
Double boiler, 4 quart size, for hot lunch

2. Individual Equipment for Each Pupil

Plated knife, fork, teaspoon
Asbestos mats
Wooden spoon

3. Dining Room Equipment Necessary for Schools Giving Four Year Course in Home Economics

1 dining table
6 chairs
1 serving table or buffet (preferably without mirror) or tea cart
1 table cloth
1 dozen dinner napkins
1 dozen luncheon napkins
6 tray doilies
1 bowl for flowers
6 knives
6 forks
6 tablespoons
6 soup spoons
10 teaspoons
12 thin, plain glasses
2 pairs salt and pepper shakers
1 water pitcher or jug
6 soup bowls or cream soup cups
12 breakfast plates
12 luncheon or small dinner plates
12 salad plates
6 bread and butter plates
1 cream and sugar
1 chop plate or 12 inch platter
2 vegetable dishes
6 cups and saucers
6 sauce dishes

Note: Simple, plain china is recommended.

4. Home Nursing and Bedroom Work

Single iron bed with springs and good mattress
2 pillows
Blankets
Bedspread
Pillow cases
Sheets
Mattress pad
First aid kit

5. Laundry

2 stationary tubs
2 ironing boards and covers
2 irons, preferably electric, and stands
2 wash boards
1 wringer
1 electric washing machine
1 dryer or rack

6. Clothing

2 waist forms (paper-built satisfactory)
Lavatory basin
½ dozen T squares
1 pair cutters shears
Tape measures for class
Cutting table or drop-leaf cutting board
One sleeve board
Pattern tissue

D. EQUIPMENT DESIRABLE AND USEFUL BUT NOT REQUIRED

1 rug
1 tea wagon
Both serving table and buffet
All equipment for twelve instead of six
Butter spreaders
Salad forks
Bouillon spoons
After dinner coffee spoons
Cream ladle
Sugar tongs or shell
Luncheon cloths
Gravy boat
Iced tea spoons
Pickle fork
6 finger bowls
Flower receptacles
4 dozen punch cups
Celery dish
Bonbon dishes
Iced tea glasses
Larger platter

MANUAL ARTS AND INDUSTRIAL EDUCATION

JUNIOR HIGH SCHOOL

Grades 7-9

Prevocational manual arts should begin in the seventh grade. Throughout the junior high school period its aim is distinctly prevocational and therefore as many different lines of work as possible for tryout purposes should be provided.

In the smaller cities where only one shop can be provided, that shop should be a general shop providing in addition to the usual woodworking equipment facilities for teaching household mechanics and elementary electrical applications in the home. The scope of such a shop can be greatly increased by the addition of a metal turning lathe, a soldering and riveting bench, and a forge and anvil. One end of the shop may be used for auto mechanics. In cities in which a vocational course in agriculture is taught, farm mechanics should be a part of the household mechanics course and for this purpose woodworking, metal working, and auto mechanics equipment is well adapted.

In the larger school systems where two shops or more are possible, one should be a general shop and the others should provide more advanced work in metal, electrical work, auto mechanics, and printing.

SENIOR HIGH SCHOOL

Grades 10-12

In the senior high school the work should become more specialized and vocational in nature. A metal working shop for a senior high school should provide for auto mechanics, a woodworking shop for cabinet making and carpentry, and an electrical shop and print shop for advanced work in these two lines. In some schools foundry work and pattern making are taught but these are properly a part of a metal working course and not distinct occupations in themselves. It is possible to conduct classes of senior high school grade in the shops described above for the junior high school.

A. STANDARD EQUIPMENT FOR WOODWORKING

The following equipment and furniture is based on a class of twenty-four students. In new buildings single benches are recommended and should be arranged in rows with space between to insure freedom of work. The light should come over the left shoulder. In old buildings where it

is necessary to economize space double benches may be used. In this case artificial light is usually necessary as the boys stand facing each other. Wherever possible the machines should be placed in one end of the room and floor space allowed for assembly work. No shop is complete without a tool room and provision must be made somewhere for washroom and lockers. The finishing room must be entirely separate from the shop and as dust proof as possible. Bleacher seats are recommended as they provide a place for seating during demonstrations as well as a place for pupils to make notes and drawings. Items starred are not absolutely necessary in a minimum equipment.

1. Machine Tools

6" to 12" jointer
*24" surface planer
Universal saw
36" band saw with upper door wire mesh and lower door sheet iron with saws 3/16" to 1/2"
Grindstone, individual motor driven
6 wood turning lathes including one with a 5 foot bed equipped with double threaded spindle and floor tool rest
The following equipment to be supplied with each lathe except items marked "g." One each of these is required as general equipment only.
1–1¼" gauge
1– ¾" gauge
1– ½" gauge
1–1¼" skew chisel
1– ¾" skew chisel
1– ½" skew chisel
g1– ¼" skew chisel
1–1" parting tool
g2– ½" round nose
g1– ¼" round nose
g1– ½" square nose
g1– ¼" square nose
g1– ½" spear point
g1– ½" right skew
g1– ½" left skew
g3 slip stone with round edges
1–6" outside calipers
1–6" inside calipers
1–8" dividers
1–12" steel rule
1–½" pint copperized oil can
1 bench brush

2. Individual Bench Equipment

18 single benches equipped with tail vise not less than 52″ with individual drawers (24 benches are necessary if lathes are not supplied)
1 bench brush
1–2′ flexible steel rule
1 marking gauge, wood, Stanley No. 65
1–14″ jack plane
1–10″ back saw
6″ try square, metal
} for each bench

3. General Equipment

(a) Knife Edge Tools
1–22″ jointer plane
2–10″ drawknives
*2– 6″ drawknives
12 sloyd knives
1 rabbet-plane
1 combination plane
6 metal spokeshaves
1 cabinet burnisher
*1 double handle cabinet scraper
12 cabinet scrapers (without handles)
2–1″, 2–¾″, 2–½″ inside bevel gauges
3–2½″ firmer chisels continuous steel handle
2–1″ paring chisels 8″ blade
8–1″ firmer chisels
8– ½″ firmer chisels
8– ¼″ firmer chisels
} if not provided on individual benches
6 extra plane blades for jack planes
4–26″ rip saws—7 point
4–22″ cross cut saws—8 point
*1–22″ panel saw—10 point
6 coping saws with frames
6 turning saws with frames (3–14″ and 3–18″)
} with extra blades
3 keyhole saws
*1 saw set
*1 evening file
*2 dozen 6″ three cornered slim taper saw files
1 hacksaw frame and 3–16 point blades
3–8″ flat mill bastard files
6–10″ half round wood files
6–5½″ bit files

6–10″ round bastard files
*1 square bastard file
3 file cards and brush

(b) Boring Tools

*3 Forstner auger bits ½″ to 1¼″
3 sets auger bits by 1/16″
3–⅛″ gimlet bits
3–¼″ gimlet bits
1 extra long ½″ drill bit
6–10″ ratchet braces
6 rose countersinks
3 expansion bits with double cutter
*1 dowel jig
3 bit gauges
1–1½″ brad awl
*1–1″ brad awl
*1 dowel pointer

(c) Miscellaneous

*1–24″ spirit level, metal
12 mallets
6–13 oz. adze eye ball face hammers
*6–12 oz. adze eye ball face hammers
*1 ball pene hammer
2 upholsterer's tack hammers
5–8″ continuous shank screw drivers
*3–6″ continuous shank screw drivers
2–4″ screw drivers
*2–½″ screw driver bits } for braces
2–¼″ screw driver bits }
12 nail sets
4–6″ sliding bevels (metal)
3–24″ framing squares
*1–18″ framing square
*1–12″ framing square
*1–17½ panel gauge
1 Yankee drill with complete set of drills
*1 set metal drills for ratchet braces
4 pairs 8″ wing dividers
8 gauges ¼″ to 2″ outside bevel
2 slip stones
2 combination India stones
1 carborundum

4–½ pint oil cans, long spout
2 monkey wrenches
2 single speed hand drills
One quart electric glue pot and glue bench
24–23″ screw clamps
6–36″ steel bar clamps
6–48″ steel bar clamps
12 adjustable Jorgensen 14″ clamps
12 adjustable Jorgensen 12″ clamps
3–6″ carriage clamps
3–8″ carriage clamps
*1 pr. 72″ cabinet clamps
1–6″ side cutting plier
1–8″ combination plier
1 brazing and soldering outfit for bandsaws
1 miter box and saw
1 dowel plate for making dowels
*1 Niagara hand grinder

B. HOUSEHOLD MECHANICS EQUIPMENT

Household mechanics may be taught in the same room as the manual training work. Slightly more floor space is needed for assembly work and some additional equipment such as soldering outfits, electrical supplies, and a representative lot of builder's hardware. Textbooks, catalogs, and the *City Building Code* are needed for reference. A list of equipment follows:

1. Builders' Hardware

1 doz. pr. butts, ball tipped pins, 3″ x 3″
1 doz. pr. butts, loose pin, ¾″ x 1 7/16″
¾ doz. catches, cupboard; German bronze
1 hasp, safety, 4½″ galvanized, wrought
½ doz. hinges wrought ornamental, 3⅞″ corrugated, butterfly
½ doz. lock set, mortise, for inside door, japanned iron case, 3½″ x 3¼″, wrought steel front, one tumbler, reversible
1 padlock, 1½″, with 2 keys similar and equal in quality to Yale and Towne Intrepid No. 543
1 pr. window sash locks, wrought steel double inverted
1 pr. window sash lifts, 1¾″ x 4″, cast metal
4 window frame pulleys, front, 4″ x 1 7/16″, dia. of wheels, 2″

2. Glaziers' Supplies

1 lb. glaziers points
10 lbs. putty (in sealed can)

10 lbs. whiting
1 glass cutter
1 putty knife
1 small sash for practice work

3. Plumbing Equipment

2 basin cocks, compression, ¼", for iron pipe, porcelain, indexed, nickel finish
2 bibb cocks, compression, ½", for iron pipe, T-handle, brass finish
2 bibb cocks, compression hose, ½", for iron pipe, T-handle, brass finish
2 bibb cocks, Fuller, ½", for iron porcelain, indexed, nickel finish
1 cesspool cover, with bell trap, 6" x 6", iron strainer
1 faucet, bath tub combination, Fuller porcelain, indexed, nickel finish
3 floats, round, 5"
1 flushing tank, low down; elevated supply valve, copper lined tank, float valve
2 sill cocks, compression; ½", for iron pipe, wheel handle, brass
1 sink, 18" x 30" cast iron, flat rim, enameled
2 traps, drum; cast iron
2 traps, S; long S for sink collar, cast iron
1 wrench Stillson 6"
1 wrench Stillson 8"

4. Plumbing Supplies

4 doz. gaskets for compression faucets, ⅝", composition rubber
2 doz. gaskets for Fuller faucets, ⅝", composition rubber

5. Soldering Bench Equipment

1 soldering bench
1 marble slab or brick
1 acid cup
1 jar for dipping solution
1 swab or brush
1 gas furnace, if electric coppers are not used
1 pr. 3 lb. soldering coppers, electric or for gas furnace
2 soldering copper handles
1 plumber's scraper

6. Soldering Supplies

2 lbs. rosin, in good sized lumps
2 lbs. salammoniac, large pieces
3 quarter-inch boxes soldering paste, "No Corrode"
5 lbs. solder wire, spool, 50-50

5 sheets tin, I. C. bright; 20″ x 28″
2 lbs. tinners' rivets

A more complete list for a unit of instruction in soldering and riveting will be found on page —. The complete list is recommended for a general shop and for farm mechanics.

A complete outline for the above course may be obtained from the State Department of Public Instruction

C. ELECTRICAL APPLICATIONS IN THE HOME

This course is a second unit of the course in general household mechanics and may be taught in the manual training shop. The equipment necessary for teaching this course is very simple and may be purchased in a neat cabinet for approximately $50.00. Complete outlines, lists of equipment, and full particulars in regard to the course may be obtained from the State Department of Public Instruction.

D. SOLDERING AND RIVETING

A soldering and riveting equipment may be added to either a wood working or metal working shop. It is particularly desirable in connection with household mechanics and farm mechanics. An outline of a unit course in this subject may be obtained from the State Department of Public Instruction.

1. Riveting Unit for Four Students

1 bench 30″ x 30″ x 6′
1 metal pad ⅜″ x 24″ x 24″
2 drawers 4″ x 8″ x 20″
1 iron vise 3½″
1 50 lb. anvil
1 breast drill with drills from 3/32″ to ⅜″—2 of each
1 ball pene hammer 1 lb.
1 riveting hammer 8 oz.
1 riveting hammer 12 oz.
1 pair tin snips 10″
1 12″ metal rule
1 45. deg. steel triangle
1 10″ file—half round double cut bastard with handle
1 10″ rat tail file with handle
1 screw driver—6″ blade
1 prick punch 4″
1 center punch 6″
1 ½″ cold chisel

2 6″ rivet sets
2 lb. 1/8″ tinners rivets
1 lb. 3/16″ tinners rivets
1 sheet 30″ x 96″—28 ga. galv. iron

2. Soldering Unit for Four Students

1 bench 30″ x 30″ x 6′ with
  1 metal-asbestos pad 24″ x 24″
  2 drawers 4″ x 18″ x 20″
1 iron vise 3½″
1 blow torch or gas furnace
2 soldering coppers—1 lb. each
2 soldering copper handles
1 pair tin snips 10″
1 scraper
1 12″ metal rule
1 12 oz. ball pene hammer
1 screw driver—6″ blade
1 prick punch
1 ½″ cold chisel

3. Supplies

3 sheets tin
1 2 oz. can flux
1 acid cup
1 jar for dipping solution
1 brush for paste
2 lbs. salammoniac—large pieces
2 sticks solder ½ and ½
1 doz. sheets No. 0 emery cloth
1 pkg. ½ lb friction tape
4 oz. hydrochloric acid

E. EQUIPMENT FOR DRAFTING ROOM

Individual Equipment—(Order one for each pupil)

1 tilting top drawing table with space for board and instruments for each student which can be locked by student
1 T square—24″, fixed head, ambro edged or wood. Ambro edge recommended
1 set drawing instruments in case containing the following: ruling pen, compass with fixed needle point, pencil point, and lengthening bar, key and lead box, plain dividers, spring bow dividers, spring bow pencil, and spring bow pen

1 30°—60° celluloid triangle—8″
1 45° celluloid triangle—6″
1 triangular scale, the foot rule graduated in sixteenths

General Equipment—(Order for the entire class)

*1 slide rule—10″
*1 beam compass
*1 T square 36″ shifting double head
2 Arkansas oil stoves 3″, very fine, with cover and case
1 trimming board
1 trimming shears
*1 set drafting instruments for instructor
1 blackboard set for instructor
6 irregular curves; 2 No. 13; 2 No. 15; 1 No. 16; 1 No. 18
4 6″ celluloid protractors
6 drawing boards, 4 only 16″ x 22″; 2 only 20″ x 26″
1 instructor's drawing table with storage space for blue prints, tracings, etc.
*1 blue print and tracing cabinet
1 printing frame
1 bath tray—galvanized

Items starred are not absolutely necessary in a minimum equipment.
To cover the cost and upkeep of the individual equipment a fee may be charged to each student.

Supplies That the School Board Should Furnish

Drafting paper in sheets
Tracing cloth
Blue print paper
Cross section paper
Ink in bulk to replenish bottles of students

Supplies That Each Student Should Furnish

1 2H or 3H drawing pencil
1 5H or 6H drawing pencil
1 art gum eraser
1 ¾ oz. bottle of water-proof drawing ink
1 emerald or ruby eraser
1 ink eraser
1 cork penholder 7″
4 lettering pens (ball points and stub pens excluded)
1 12″ x 17″ drawing-board (can be made by student if a manual training shop has been established)

6 thumb tacks 3/8" to 1/2" in diameter

Outlines and suggestions for drawing courses may be obtained from the State Department of Public Instruction.

F. AUTO MECHANICS

The equipment listed here for auto mechanics is complete for this special work. Machine work must necessarily be done in a machine shop. If a complete machine shop is not available, good work in auto mechanics may be done in a shop supplied with a lathe, drill press, and bench grinder with necessary tools for these machines and bench and auto equipment. The machine tools are not absolutely necessary in a minimum shop. The tools and supplies listed here are especially for auto mechanics and are not general machine shop tools. Items starred are not absolutely necessary in a minimum equipment.

1. Auto Mechanics Equipment

1 universal engine stand
*1 Ford engine stand (C-O junior)
*1 20 ton garage press
*1 axle stand
*1 straightening press (Geier No. 2F)
*1 connecting rod aligning fixture with bushings
*2 heavy twin jacks
2 heavy single jacks
*1 brick top welding bench 24" x 36" (made by class)
*1 acetylene welding outfit
*3 Type B Prest-O-Lite tanks and manifold

2. Demonstration Equipment

1 cut-away unit power plant
1 cut-away rear axle
} made by class
1 Ford chassis in running condition
*1 engine and stand for demonstrating various carburetors and ignition systems
As many representative parts of cars as possible

3. Small Tools

*1 electric drill 1/2" garage special
1 gear and wheel puller
1 valve refacing and re-seating outfit
1 valve grinder
2 valve lifters

1 general purpose screw plate
"Adamantine" cutting machine screw, USS and SAE threads
1 set garage service No. 23 Walden-Worchester socket wrenches
*1 set inter-changeable No. 9 Walden-Worchester socket wrenches
1 combination tappet wrench set Williams No. 50
1 combination automobile S wrench set Williams "Big Ten"
*1 set expansion reamers ½" to 1" by 16ths
*1 Yankee swivel vise 3⅛" opening
1 set Ezy-outs
1 set bearing scrapers
1 auto pry bar 7/16" x 14"
1 double end spark plug wrench
1 set taper pin reamers No. 0 to No. 5
1 set shim punches ¼" to 7/16"
4 long pin punches 5/16"—1¼"—7/16"—⅜"
2 screw drivers 10" blade
1 offset screw driver 6"
1 rubber mallet
1 wire cleaning brush 1" x 5"
*1 18" monkey wrench
1 8" G. T. D. Little Giant pipe wrench
*1 14" G. T. D. Little Giant pipe wrench
*1 Internal micrometer set } machine shop
1 combination outside micrometer set 1" to 5" }
1 electric vulcanizer 3½" x 7" heating surface } for tire repair work
shaler No. 83D }
1 set tube repair tools in roll }
1 tire pump and gauge }
*1 set radiator test plugs
1 grease gun
1 spring leaf spreader
1 lead hammer mold
1 hack saw frame 8" to 12"
12 hack saw blades, soft back, 8"
1 thickness gauge
2 cold chisels, ¾"
1 oil can
1 pair side cutting pliers, 7"

4. Tools Each Student Should Own

1 pr. 7" universal pliers
1 screw driver 6" blade
1 6" adjustable S wrench

5. Electrical Service Equipment

*1 universal testing bench with motor and double six storage battery
*1 battery charging outfit
1 hydrometer syringe
*1 cadinum volt meter
1 ignition wrench set
*1 lead burning outfit
*1 water still
*2 complete ignition heads and coils (Delco and Atwater Kent)
*1 magneto—any standard make
4 Columbia igniter dry cells
25 ft. lamp cord

6. Auto Mechanics Supplies

1 box 1000 assorted cotter pins
1 box 300 assorted standard SAE lock washers
1 box 50 assorted taper pins
*1 box assorted imperial compression tube couplings
*1 box 200 assorted gaskets Victor No. J V 22
1 box shim stock 500 sq. in. .002 to .015
2 8 oz. box valve grinding compound, fine and coarse
1 box 200 assorted USS and SAE nuts
1 box 100 assorted USS and SAE cap screws
1 box 200 assorted stove bolts
1 qt. gasket shellac
1 lb. vulcanizing cement
2 lb. raw tube stock
1 sheet cork ⅛ x 12 x 36
2 lb. sheet packing 1/32" Tenax
12 assorted files
1 lb. soft solder
1 can soldering paste

An outline of a Junior High School prevocational course in auto mechanics with list of minimum equipment may be obtained from the State Department of Public Instruction.

G. FORGE EQUIPMENT

The following list of equipment is designed to take care of four students in a general shop or a metal working shop. It would seem a very desirable addition to any small town or consolidated school shop located in an agricultural community. Additional groups of four could be accommodated by omitting vise, sledge, and hack saw from every second unit.

1 cast iron forge
(No. 843E Buffalo or similar size with electric blowers and water tank)
2 steel anvils 125 lb.
1 40 lb. solid box leg vise 4" jaw
1 10 lb. sledge cross pene
2 1¼" hardie
6 prs. tongs—straight lip–18"
2 prs. bolt tongs 18"
2 prs. pickup tongs 18"
2 ball pene hammers 1¼ lb.
1 ball pene hammer 2 lb.
1 heavy frame hand hack saw 12"
1 hot cutter 1¼"
1 cold cutter 1¼"
1 set hammer 1⅛"
2 heading tools ½"
2 center punches 6"
1 hot punch or drift ⅜"
1 12" double cut bastard half round file
1 10" mill bastard file
12 12"—14 teeth soft back hack saw blades
1 heavy bench—30" x 30" x 6' with 4" x 18" x 20" drawer

An outline of a unit course in forge work may be obtained from the State Department of Public Instruction.

H. METAL WORKING EQUIPMENT MACHINE SHOP

Metal working allows a wide range of instruction. The equipment here listed is based upon machine shop work in which forge work and soldering and riveting may be introduced as special units rather than separate and distinct courses.

Auto mechanics is very important in this state and should be treated as a separate and distinct course growing out of and based upon machine shop work. In planning a machine shop the possibility of an auto repair shop in connection with it should always be considered.

Standard machine tool equipment satisfactory for both vocational and prevocational work has been listed. Smaller lathes, such as 6" bench engine lathes, may be used for prevocational work, and vocational courses not more than one year in length. The list of general tool equipment has been made very complete and represents the best practice. It is not expected that the entire equipment will be purchased at one time or for a single shop. It is a list from which an instructor must select that best suited to the courses proposed and within the range of local possibilities.

Sizes have been carefully given in order to guide an instructor in selection and ordering. Items starred are not absolutely necessary in a minimum shop and where two numbers are given the first is the minimum.

A list of light machine tool equipment suitable for prevocational work or vocational courses one year in length may be obtained from the State Department of Public Instruction. The following list is standard.

1. Machine Tools

*1 16"–8' engine lathe 3 step cone double back gear. Quick change gear box, taper attachment and set of collets ¼—1" by 1/16, equipped with chasing dial for cutting threads
*1 12" independent 4 jawed chuck cast iron body and steel jaws
*1 No. 2 S Armstrong tool holder ⅜" capacity
*1 No. 2 R Armstrong tool holder ⅜" capacity
*1 No. 2 L Armstrong tool holder ⅜" capacity
*1 No. 74 L Armstrong offset cutoff tool
*1 No. 1 K Armstrong knurling tool
*1 No. 9 Armstrong boring bar
*1 No. 4 Jacobs drill chuck
*1 No. S–52 spring nick tool holder for cutting threads
*1 tool post electric center grinder
*1 doz. ⅜ x ⅜ high speed tool bits
5 12"—6' screw cutting engine lathes 4 step cone single back geared, quick change gear box, size to correspond with Monarch or its equivalent, 1 lathe to have taper attachment

2. Lathe Equipment

1 8" independent 4 jawed chuck for each lathe
5 No. 1 S Armstrong tool holder 5/16" capacity
1 No. 1 L Armstrong tool holder 5/16" capacity
1 No. 1 R Armstrong tool holders 5/16" capacity
1 No. 31 L cut off tool
1 No. 9 boring bar ¾" dia.
1 No. 1 K knurling tool
1–6 set lathe dogs ½" capacity to 1" (bent tail)
1–2 each lathe dogs 1⅛—1¼—1⅜—1½—2 (bent tail)
1–2 each No. 11 and 12 clamp dogs
*1 set lathe arbors ½"—1⅛" by 1/16"
1 No. 3 Jacobs drill chuck

3. Machine Tools (Cont.)

*1 Universal Milling Machine (size equivalent to a No. 2 Brown & Sharp) For a minimum shop substitute one South Bend lathe milling attachment.

4. Milling Machine Equipment

*1 universal dividing head (5" height of centers)
*1 swivel milling vise
*1 cutter arbor 7/8" diameter } Size of taper
*1 cutter arbor 1" diameter } to fit machine
*1 arbor for shell-end mill 3/4" dia.
*1 collet taper No. 10—7 } for end mills with taper shanks
*1 collet taper No. 7—5 }
*1 6" universal 3 jaw chuck
*1 6" universal 3 jaw chuck
*1 No. 4 Jacobs drill chuck (or its equivalent)

Milling cutters (for milling machines or milling attachment only)

*1 set plain milling cutters 3/16" x 5/8" x 1/16" to fit arbor
*1 spiral flute milling cutter 2 1/2" x 4" to fit arbor
1–2 1/2" x 4" side milling cutters to fit arbor
1–2 1/4" x 4" side milling cutters to fit arbor
*1 45 deg. angular cutter to fit arbor
*1 30 deg. angular cutter to fit arbor
*1 set involute 10 pitch gear cutters (or the same pitch used by the manufacturer for cutting gears used on lathes)
1 1/8" x 6" metal slitting saw to fit arbor
1 1/16" x 4" metal slitting saw to fit arbor
*1 set end mills 1/2" to 1" by 1/16" No. 7 taper (spiral flute)
*1 set end mills 1/4" to 1/2" x 1/16" No. 5 taper (spiral flute)
*1 shell end mill (spiral flute) 3/4" x 1 5/8" x 1 3/4" long

(If the lathe milling attachment is to be used substitute 1 each 1/4", 1/2" and 1" end mills to fit lathe)

1 16" back geared shaper

5. Shaper Equipment

1 No. 2 R tool holder 3/8 capacity
1 No. 2 L tool holder 3/8 capacity
1 No. 2 S tool holder 3/8 capacity
*1 No. 47 extension shaper tool 3/4" x 10" bar 5/16" cutter
1 pair each parallels, size 1" x 2" x 12", 3/4" x 1 1/2" x 10", cast iron
*1 pair each parallels, size 1/4" x 1" x 6", 7/16" x 3/4" x 6", steel ground
*1 20" upright drill, back geared

6. Drill Press Equipment

*1 No. 4 Jacobs chuck (or its equivalent)
*1 flanged drill press vise, size of jaw 2" x 7 1/8", opens 4 1/2"
1 sensitive drill press 5/8" capacity, No. 2 Morse in spindle
1 No. 3 Jacobs drill chuck (or its equivalent)

1 flanged drill press vise, size of jaw 1 1/16" x 4 1/8", opens 2"
1 pedestal two wheel tool grinder (make more in shop if needed)
2 emery wheels size to suit bench grinder
*1 power hack saw
*1 arbor press
*1 tool and cutter grinder } or one universal grinder
*1 cylindrical grinder }
*emery wheels for grinding cutters
*1 set norton wheels, size and shapes No. 42-59 suitable for cutters
*1 precision bench lathe
*1 set collets 1/16" to 1/2" by 1/64
*1 face plate
*1 5" universal chuck
*1 No. 3 Jacobs chuck

7. Measuring Instruments

6–15 4" outside calipers
1–15 4" inside calipers
3 pr. dividers 4"–6"–8" (for minimum 1–6")
1–2 pr. hermaphrodite calipers
1–6 12" combination sets with reversible protractor head
6–15 6" tempered steel rules
3 60 deg. center gauges for setting threading tool
*1 6" rule depth gauge
1 12" hardened cast steel try square
1 9" universal surface gauge
*1 set standard caliper gauges 1/4"–2 1/2" finished both ends
*1 twist drill and steel vise gauge
1 jobbers drill gauge
*1 dial test indicator
*1 speed indicator
*1 mercury plumb bob
2–6 scribers (double point 8" long)
1 each micrometers 0–1", 1"–2", 2"–3", 2"–6" (for minimum 1–1")
*1 inside micrometer 2" to 9 1/2"
*1 screw thread micrometer caliper 8 to 13 thds. per in. USS
*1 screw thread micrometer caliper 14 to 12 thds. per in. USS
*1 20" hardened steel straight edge
*1 12" vernier caliper
1 screw pitch gauge V threads—30 pitch
1 thickness gauge, size from .0015 to .015 in thickness
*1 steel beam trammels with 13" beam and extension

*1 key seat rule 12″
*1 pr. 10″ firm joint outside calipers
*1 pr. 10″ firm joint inside calipers
1 25 ft. steel tape
*1 12″ machinist's level

8. General Equipment

6–15 1 lb. machinist's hammers
1 2 lb. machinist's hammer
*1 6″ screw driver
1 10″ screw driver
*1 12″ screw driver
6–15 machinist center punches 4″
1–4 machinist center punches heavy type
1–4 flat chisels
1–4 cape chisels
1–4 Diamond point chisels
1–2 center chisels
1–2 oil stones 1″ x 2″ x 8″
1–2 slip stones ¼″ x ¾″ x 4″
1 pr. 12″ tin snips
2 4″ C clamps
*1 pr. tool makers clamps 2½″ capacity
1–3 adjustable hack saw frames 8″ to 12″
1 doz. 14 point 10″ hack saw blades with soft backs
1 breast drill ½″ capacity
1 set 3/16″ figures
*1 set 3/16″ letters

9. Bench and Bench Equipment

24′ of bench space
5 vises 3½″ jaw (one vise preferably a swivel)
1 vise 4½″ jaw
1 bench plate for each vise 2″ x 12″ x 14″ (to be made in shop)
1 muffle furnace or forge
1–2 125 lb. steel anvils and tools
1 10 lb. sledge hammer
1 blow torch and soldering iron, (electric)
1 babbit ladle
1 lead hammer mold
*1 belt lacing machine
*2 angle plates (cast iron) 6″ x 6″ x 7″
3–6 bearing scrapers
1–2 flat surface scrapers 1″ wide

10. Drills and Reamers

*1 set taper shank drills ½" to 1" by 32ds
*1 set straight shank twist drills with stand No. 1–60
1 set straight shank twist drills 1/16" to ½" by 64ths
1 doz 30 x 30 center drills
*1 doz letter E center drills
*1 1 to 2 morse taper sleeve
*1 2 to 3 morse taper sleeve
*1 3 to 4 morse taper sleeve
1 set hand reamers square shank ½" to 1"
*1 set rose chucking reamers with straight shank ¼ to ¾ by 1/16th
*1 No. 1 morse taper reamers
*1 No. 2 morse taper reamers
1 set taper pin reamers No. 1–6
*1 tap wrench 6" long
*1 tap wrench 10" long
*1 tap wrench 15" long
1 small socket T tap wrench
*1 large socket T tap wrench

11. Taps and Dies

*1 set taps and dies ¼" to 1" USS
*1 set taps and dies ¼" to ¾" SAE
*1 set machine screw taps and dies 4-36 to 14-20
*1 set pipe taps ⅛" to 1" } with wrench and stock
*1 set pipe dies ⅛" to 1" }
*1 pipe cutter ¼" to 1" with bit cutter
(For a minimum shop substitute 1 general purpose screw plate "Adamantine" or similar)

12. Wrenches

*1 6" adjustable S wrench
1 8" adjustable S wrench
*1 6" monkey wrench
1 12" monkey wrench
*1 6" stillson wrench
1 12" stillson wrench
*1 set double end wrenches (straight or S) ¼" to 1"

13. Files

*1 doz. flat mill bastard 8"
*1 doz. half round bastard 10"

*1 doz. round bastard 8″
*1 doz. square bastard 8″
*½ doz. three square 7″ slim taper
*1 doz. each file handles No. 1, 2, 3
*½ doz. file cards and brush
(For minimum shop substitute 12 assorted files and one file card and brush)

The State Department of Public Instruction will be glad to furnish outlines of unit courses in machine shop work and to consult with instructors on the selection of equipment.

I. PRINTING EQUIPMENT

Printing equipment varies considerably with the scope of work to be done. The equipment here listed is that recommended by the National Association of Printing Instructors at their convention in Indianapolis and is sufficient for a wide range of work in a class of 15 to 20 pupils. The list should be checked by the instructor with the help of local printers so that what is selected may suit local conditions and grade of work to be done

Equipment List

500 lbs. 10 point Century Old Style, with spaces and quads
25 lbs. 6 point Century Old Style, with spaces and quads
25 lbs. 8 point Century Old Style, with spaces and quads
25 lbs. 12 point Century Old Style, with spaces and quads
25 lbs. 14 pt., 18 pt., and 24 pt. Century Old Style, same
3 fonts each—6, 8, 10, 12, 18, 24 pt., Cheltenham Bold
2 fonts each—30, 36, 48, 60, 72 pt., Cheltenham Bold
3 fonts each—8, 12, 18, 24 pt., Century Old Style Italic
3 fonts each—three different sized faces 6 pt. light face Gothic
3 fonts each—three different sized faces 12 pt. light face Gothic
3 fonts each—three different sized faces 6 pt. heavy face Gothic
3 fonts each—three different sized faces 12 pt. heavy face Gothic
2 fonts each—8, 10, 12, 18, 24 pt., text letter—Cloister Black
2 lbs. 10 point Century Old Style braces and dashes
2 lbs. 10 point Century Old Style fractions
2 lbs. 10 point Century Old Style references
1 lb. each of the above in 8 and 12 pt. Century Old Style
5 lbs. 10 point dot leaders
5 lbs. 10 point line leaders
5 fonts type borders and ornaments
10 only flat top extension front type cabinets, each equipped with two pairs of case brackets and two pairs of news or book cases.

(This is No. 2205 American Type Founders Company, and the placing of the brackets on cabinets is similar to the Wisconsin window cabinet. The cases should be consecutively numbered.)

1 only metal furniture case
2 only rule cases
2 only lead and slug cases
4 only triple cases
2 only space cases
3 only quad cases
25 lbs. each 8, 10, 12, 18, 24 pt. additional spaces and quads
10 lbs. each 30, 36, 48, 60 pt. additional spaces and quads
10 only 6x2 composing sticks
6 only 10x2 composing sticks, Star or Rouse
2 only 12x2 composing sticks, Star or Rouse
(The six inch sticks may be plain adjustable, similar to the Buckeye composing stick.)
25 only 8x10 rigid rim steel galleys
6 only 10x16 rigid rim steel galleys
15 only 5x23¾ rigid rim steel galleys
1 only case, composing rules
10 lbs. 2 pt. labor saving hair-line brass rule
5 lbs. 2 pt. labor saving brass rule with ¾ or 1 pt. face on side
100 lbs. metal furniture
100 lbs. 6 pt. labor-saving slugs
100 lbs. 2 pt. labor-saving leads
1 font wood furniture—lengths 10 to 60 picas
1 font reglet, with cabinet—lengths to 60 picas
1 each mallet, planer, benzine can
1 only proof press—Washington hand press. A potter
1 only imposing table 36 x 60 inches with chase rack or letter boards
1 only galley cabinet to hold 5 x 23¾ galleys
1 only galley cabinet to hold 6 x 10 galleys
1 only 8 x 12 Chandler and Price—New Series Gordon—platen press with rollers and chases, equipped with short fountain and safety guards
1 only 12 x 18 Chandler and Price—new series—platen press with rollers and chases, equipped with long fountain and safety guards
2 only extra chases
3 only variable speed motor for presses
1 only platen pressroom cabinet
1 only ink and roller cabinet
4 doz. quoins, key gauges, benzine cans, ink knives

1 only wire stitcher or stapler
2 only tables for folding and bindery work—36″ x 72″
1 only 30″ power paper cutter
printing inks and paper stock
oil cans, tools, and accessories

The foregoing list includes only the mechanical equipment. A comprehensive series of textbooks for apprentices, covering printing and the allied industries, has been published by the United Typothetae of America. A full description of these textbooks will be found on pages 29 to 34 of *Instruction in Printing in Public Schools.*

MANUAL TRAINING

A. SHOP EQUIPMENT FOR TEACHING MANUAL TRAINING IN RURAL AGRICULTURAL SCHOOLS

1. Single Benches and Equipment

Number determined by size of class

Wooden tail vise
Ripsaw
Jack plane
Block plane
Rapid acting steel vise
Back saw
Steel 2 inch rule
6 inch try-square
Compass and pencil
Knife
Marking gauge
Bench hook
1 inch chisel and brush
¾ inch chisel and brush

2. General Tool Cabinet

2 large cross cut saws
1 compass saw
1 coping saw
1 turning saw
1 brace
1 large try square 12 inch
5 hammers
2 mallets
2 scrapers
2 screw drivers
1 hand drill
1 steel divider
2 brad awls
2 scratch awls
1 bit gauge
1 draw shaver
5 nail sets
2 countersinks

1 T bevel
1 monkey wrench
6–6 inch clamps
2–3 foot cabinet clamps
1 carborundum stone
2 plyers
6 different size chisels
6 different size gauges
4 wood files
2 steel files
12 different size bits

3. Supply Cupboard

Assortment of flat and round headed screws
Assortment of brads and nails
Cup hooks
Tacks
Glue
Wax
Burnt umber
Lamp black
Pencils
Erasers
Compasses
Hinge (few)
Sandpaper
Shellac
Turpentine
Cotton waste
Oil
Oak filler
String
Hat hooks
Vise part repairs
Plane part repairs
Marking gauge

4. Reasonable Amount Furnished to all Boys

Framing square
Jointer plane
Expansion auger bit
End cutting pliers
Oil can

Glue pot
Double boiler
2 files 8 inches and 10 inches, flat
1 matching plane
1 cold chisel
1 pair of tin shears
1 saw-filing clamp
2 center punches
Set of lockers (boy's work)
Power grinder or emery wheel
Miter box or saw
Saw horses
Stock room for lumber. Lumber furnished to boys for all required work or small optional models
Staining table
Sink
Teacher's desk
Pencil sharpener

5. Personal Equipment For Each Student

1 apron
1 flat brush 2 inches wide for general purposes
1 flat chisel point varnish brush 2½ inches wide
1 ½ pint can cold glue
1 plane iron (to be furnished by school)

KINDERGARTEN FURNITURE AND EQUIPMENT

Work bench with vise
Chest of tools which includes saws, hammers, brace and bits, screw drivers, plane, etc.
Sand table
Piano
Kindergarten chairs 12″ high
Kindergarten tables 20″ high
Dollhouse
Maypole
Well selected pictures
Plant boxes
Outdoor equipment
- Football
- Large rubber ball
- Ropes, varieties
- Slide
- Wagon, express
- Sleigh
- Trapeze
- Snow shovel
- Garden tools
- Bean bags
- Marbles
- Ladders
- Swings
- Horizontal bar

MATERIAL FOR HAND WORK

- Scissors
- Clay
- Conductor's punch
- Water color paints and camel hair brushes
- Clothespins
- Colored crayons
- Colored beads
- Paper fasteners
- Yarn
- Tapestry needles
- Soft wood for wood working
- Glue
- Shellac

Hill floor blocks
Paper cutter
Weaving materials

No attempt has been made to give all the equipment that may be useful in a kindergarten department. The kindergarten teacher should be consulted when a kindergarten room is planned and when the furniture and equipment are provided.

FURNITURE AND EQUIPMENT FOR THE VARIOUS SCIENCES

BIOLOGY ROOM

The Following Furniture and Equipment is Planned for a Class of Twenty-Four Pupils

6 or 12 desks for 4 or 2 students each, each desk to have sink and water and gas connection
24 students' chairs
One instructor's demonstration desk with water, gas and electricity connections and provided with a sink
One instructor's chair
Cupboards with shelves and glass door for museum material
Cupboards with drawers and doors for equipment and material
Filing cases for bulletins and case for reference books
Conservatory with glass sides for fish
Growing tables for plants
Sink, shelves, dirt boxes
Movable aquaria, beehive and bees, cages for live animals, birds, and other life for study
Incubator
Charts, models, skeletons, specimens, mounted insects, and selected microscropic mounts
Lantern for demonstration work
Pictures of birds, fishes, reptiles, insects, and other life for study
Herbarium
Compound microscopes
Dissecting microscopes
Instruments for dissecting
Charts
Locker space for each pupil
Equipment for each student
Growing room
Specimen bottles and cans
Germinating plates, pans, and boxes
Thermometers
Bunsen burners or alcohol lamps
Glassware
Such other material and apparatus as is determined necessary by the teacher for good work

The equipment should be selected by an experienced teacher after acquaintance with the community and its needs. Natural conditions and accessibility to natural conditions vary so that the equipment will vary accordingly.

PHYSICS ROOM

The Following Furniture and Equipment is Planned for a Class of Twenty-Four Pupils

Six tables to accommodate four pupils each
Teacher's or instructor's desk and chair
Cases to hold apparatus and notebooks
Tables for balances, stoves
Twenty-four stools or chairs for pupils
Gas and a plug for electricity at each table
Cases with master key for pupils' equipment
Cupboard or case for reference books
Shelf along windows for experiments requiring sunlight
Sinks for students' use

LECTURE ROOM

One large instructor's table equipped with water, gas, and electrical connections and built so that it will serve as a demonstration table for both chemistry and physics
Apparatus cases
One sliding blackboard
Blackboard space in the room
Screen for lantern work
Dark shades for darkening room
Seats elevated for students

CHEMISTRY ROOM

The Following Furniture and Equipment is Planned for a Class of Twenty-Four Pupils

Tables allowing space enough for individual work by each student with individual lockers. Tables may be built locally.
Water, gas, and electrical connections for each table
Shelves for reagents, fireproof, if near lamps
General hood for gases
Balances for accurate weighing; also balances for rough weighing
Cases for apparatus and chemicals
One demonstration table with drawers

One set of sliding blackboards or blackboards in the room
One balance table
One case for reference books
Test tube racks
Generators—at least one Kipp generator of 500 C. C. capacity or greater if possible
Drying oven—inexpensive sand bath may be use for most operations
Apparatus for distilling water—three Liebig condensers
Meter sticks
Electrolysis apparatus
Dry cells or 6 volts storage battery
Lantern for demonstration purposes
Balances for Quantitative work—sensitive to 1 mg.
Pneumatic troughs
Rods and standards
Clamps
Glassware for general experiments—plenty of Florence and Erlenmeyer flasks of assorted sizes; also plenty of beakers
Reagent bottles
Mortars and pestles
Barometer—mercurial
Glass tubing of assorted sizes
Rubber tubing of assorted sizes
Crucibles
Blow torch—If laboratory is fitted up with gas, Meker burners
Retorts
General desk equipment used by the student in performing experiments

PHYSICS AND CHEMISTRY ROOMS

Additional Equipment

The equipment for physics and chemistry should be selected by an experienced and competent teacher. The school district should furnish such other equipment as is needed for first class work. Enough equipment should be provided for chemistry so that *independent* and *individual* work can be done by each student. In physics two students may work together. Experiments in which there is an element of danger or which require very precise operation or measurement should be performed by the instructor as demonstration experiments. There is no need for having such extremely poisonous chemicals as Potassium Cyanide around a high school chemical laboratory. Operations involving the generation of hydrogen or the cutting or use of yellow phosphorous should be under close supervision of the instructor.

Apparatus and Equipment for Smith-Hughes Schools

Schools receiving funds from the state and national government through the operation of the Smith-Hughes law should consult the Supervisor of Agricultural Education, Department of Public Instruction, Lansing, relative to the furniture and equipment needed. The following, however, is a list of the furniture required in the schools operating under the Smith-Hughes law.

Furniture

Laboratory table provided with gas and water
Flat top tables of the usual height and 42" wide and of lengths suitable to the room
Cupboards for storing materials
Drying oven
Grindstones
Soil bins

Equipment

For further information concerning furniture and equipment for the teaching of agriculture in school districts operating under the provisions of the Rural Agricultural law, write the Superintendent of Rural Education, Department of Public Instruction, Lansing, Michigan.

Boards of education of school districts that have agriculture as one of the school subjects should provide furniture, equipment, and apparatus for effective work in this subject.

Apparatus and Equipment for Rural Agricultural Schools

Below is given a list of material and apparatus that are to be provided by the boards of education in Rural Agricultural Schools for the teaching of agriculture

One compound microscope magnifying to 500 diameters, two eye-pieces and two objectives
One balance, weighing to centigrams
One spring balance
Lenses or small magnifying glasses. (Students should own these)
One Babcock milk-testing outfit complete, with special bottles for testing skim-milk
One graduate, 100 cc
Three thermometers
One dozen pint fruit jars
One dozen quart fruit jars
One dozen four inch flower pots, with saucers, and one dozen six inch

One-half dozen beakers
Three tall lamp chimneys, or large glass tubes
Four dozen test tubes, assorted sizes
Six porcelain crucibles
Alcohol lamps or gas burners if gas is provided
One set of samples of fertilizing materials
Lime, alfalfa, and the other clover seeds
One-half pound copper sulphate
One pound resin
One-fourth pound tallow
One ball No. 18 knitting cotton

Bottles, tin cans, and other supplies may be brought from home by the students as needed

If material and apparatus other than that prescribed in the foregoing list become necessary for efficient work, boards of education should see that they are provided.

If any of this apparatus and equipment has been provided in any department of the school and is available for the work in agriculture, it need not be duplicated.

Glue pot
Double boiler
2 files 8 inches and 10 inches, flat
1 matching plane
1 cold chisel
1 pair of tin shears
1 saw-filing clamp
2 center punches
Set of lockers (boy's work)
Power grinder or emery wheel
Miter box or saw
Saw horses
Stock room for lumber. Lumber furnished to boys for all required work or small optional models
Staining table
Sink
Teacher's desk
Pencil sharpener

5. Personal Equipment For Each Student

1 apron
1 flat brush 2 inches wide for general purposes
1 flat chisel point varnish brush 2½ inches wide
1 ½ pint can cold glue
1 plane iron (to be furnished by school)

KINDERGARTEN FURNITURE AND EQUIPMENT

Work bench with vise
Chest of tools which includes saws, hammers, brace and bits, screw drivers, plane, etc.
Sand table
Piano
Kindergarten chairs 12" high
Kindergarten tables 20" high
Dollhouse
Maypole
Well selected pictures
Plant boxes
Outdoor equipment
- Football
- Large rubber ball
- Ropes, varieties
- Slide
- Wagon, express
- Sleigh
- Trapeze
- Snow shovel
- Garden tools
- Bean bags
- Marbles
- Ladders
- Swings
- Horizontal bar

MATERIAL FOR HAND WORK

- Scissors
- Clay
- Conductor's punch
- Water color paints and camel hair brushes
- Clothespins
- Colored crayons
- Colored beads
- Paper fasteners
- Yarn
- Tapestry needles
- Soft wood for wood working
- Glue
- Shellac

PLUMBING

The plumbing for school buildings should be of the best material and the best practice should be followed in installing the plumbing work and the making of connections to outlets. Many cities now have plumbing codes which prescribe the kind of material that must be used for outlets. Those planning the building should take the same precaution as they would when compelled to follow a code. The pipes should run parallel to walls and ceiling unless there is a very good reason for some other construction and there should not be an unnecessary use of elbows. The valves should be packed with material that will not make them difficult to turn because of the swelling of the packing. The plumbing should be a part of the plans and it should be laid out with a knowledge of the water mains, sewers, elevations, and other factors that might affect the plumbing of the building. The plans should show definitely the location of pipes, drains, and all connections. The plumbing of the building should be such that the soil pipe can be given a pitch that will allow sewage to be disposed of without danger of clogging the pipes and drains.

TOILETS

Toilet rooms for school buildings should have as careful consideration as any other part of the building. Those in charge of their construction should not lose sight of the fact that there is a moral, physical, and health problem to be considered when installing this part of the school equipment.

Toilet rooms should not be located in the basement with supervision only during intermission. A better arrangement is to have toilet rooms located on each floor with sufficient facilities to accommodate the pupils on that floor. This arrangement lessens the stair climbing and reduces supervision to a minimum.

The walls and ceiling of the toilet rooms should be light colored so that any dirt may be easily seen. If this color is used there will be less chance of dirt remaining. White glazed brick or tile set in cement is a good wall for a toilet room. The floors of the toilet rooms should be terrazzo, asphalt, glass, marble, or other non-pervious, non-absorbing composition. They should never be made of cement even if it is treated with some kind of hardener or paint. Cement is not a good sanitary material for floors for such rooms. The floors should be provided with drains for easily flushing the floors with a hose.

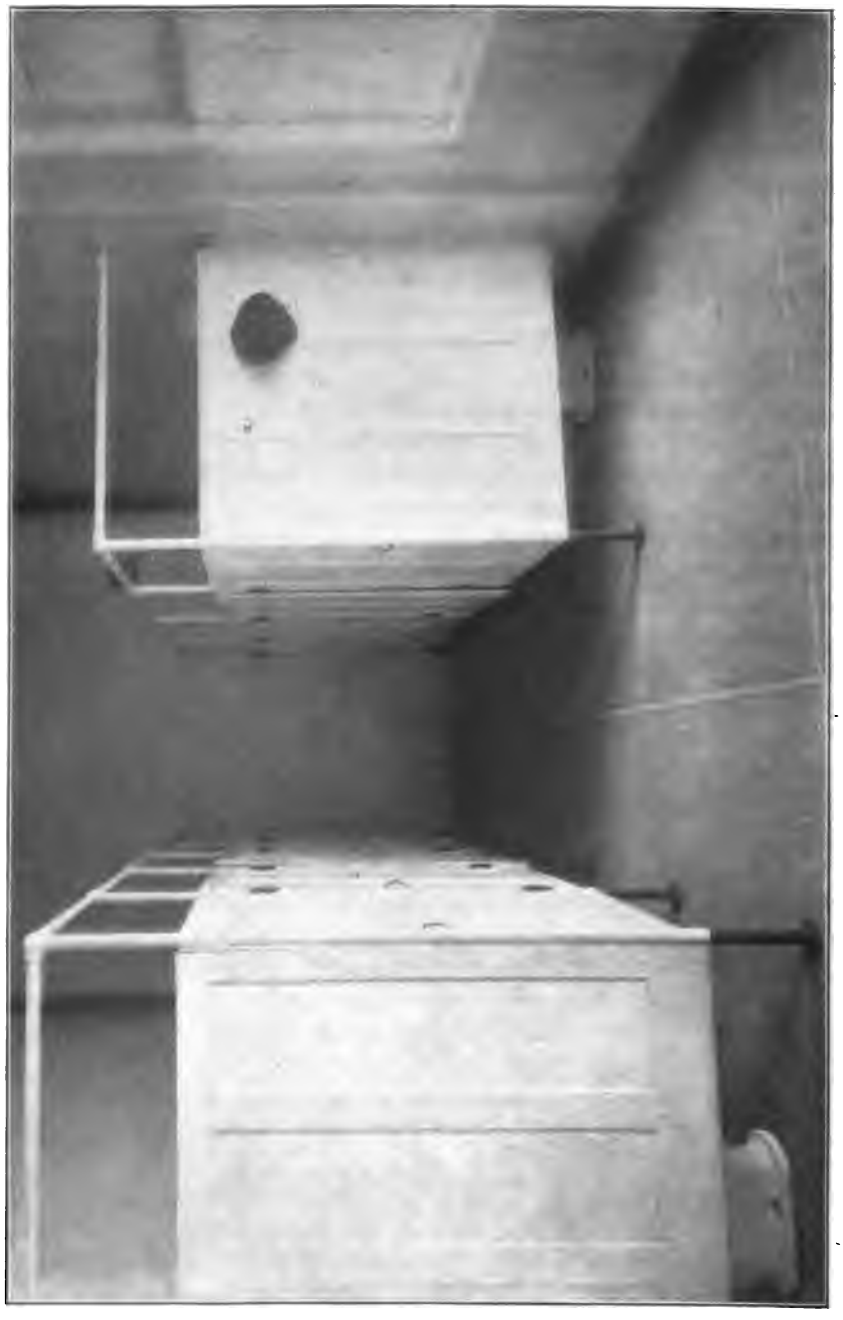
Provision should be made for different sizes of seats for primary children. The number of toilet fixtures to be installed should be not less

than one seat for each fifteen to twenty girls, and one seat and one urinal for each twenty-five to thirty boys. The body of the toilet should be of vitreous ware which is not easily scratched, stained, or broken, and the seat should be glass, porcelain, or other impervious material with open front. The seats should be separated by partitions which are impervious to moisture, light in color, and of a substance that is not easily defaced. The plumbing should be easily accessible.

Teachers should have separate toilet rooms and lavatories. If rest rooms are provided, the toilet and lavatory can be arranged adjacent to this room. The toilet and lavatory for the superintendent and the principal should be arranged adjacent to their offices.

Every toilet room should be located where there will be sunlight in the room. This is essential from the standpoint of health. The rooms should also be located not only with the idea of convenience to the schoolroom but also with a maximum of privacy.

There cannot be the best of physical health if there is not the best or moral surroundings. If the pupils have filthy, unventilated toilet rooms with walls covered with filth and obscene writing there cannot be the highest standard of morality in the school. If those constructing school buildings will keep this in mind the toilet rooms will be among the best rooms in the building and the fixtures will be of the best type and make. The toilet rooms should be thoroughly ventilated with a ventilating stack entirely separate from the other ventilating apparatus of the building. In school buildings having provision for mechanical ventilation, the toilet rooms should be connected with an exhaust fan. There should be such a pressure on the toilet rooms at all times that the air will not pass from the toilet rooms to the corridors when the doors are opened.



A Girls' Toilet

LAVATORIES

Near the doors of the toilet rooms should be vitreous china lavatories provided with hot and cold water attachments. Liquid soap and paper towels should also be provided.

SINKS

The sinks installed should be of the best porcelain enameled ware with rolled rims and where set against the wall should be provided with backs.

SHOWERS

See the discussion of showers in connection with the discussion of the gymnasium.

WATER SUPPLY

The water supply for the school should be sufficient for the toilets and drinking fountains at any time of the day, play periods as well as study periods. There should be a uniform pressure on drinking fountains so that at play periods the pressure will not become so low that children will place their lips on the cup of the fountain in order to get water.

VACUUM CLEANERS

Vacuum cleaners are desirable for new buildings, for when properly installed, they remove the dirt from the rooms without scattering dust about to settle on the walls, furniture, and equipment. If a vacuum system is installed, the pipes should be located so that the cocks to which the hose are attached are close enough together for the janitor to do the cleaning without having to drag several feet of hose about the building.

FIRE PROTECTION

Provision for protection from fire should be made at the time of the construction of the school building. If the building is located in a city that has certain requirements, these requirements should be complied with. If there is water connection so that the building has the fire protection of the city or village, there should be provided pipes and hose as a part of the schoolhouse construction. The hose connections should be on every floor and located so that not more than 75 feet of hose will be needed at any connection to reach all parts of the building on the floor in which it is located. Proper racks should be provided for hose. See page 29 for further discussion.

FIXTURES

The fixtures should be the best on the market. It is poor economy to buy any other kind. The usage that fixtures in public buildings receive makes it necessary that only the best be installed.

ROOF DRAINS

The roof drains should be connected directly with the sewer and they should come down where there is no danger of freezing or damaging the walls either inside or outside.

CESSPOOLS AND SEPTIC TANKS

Cesspools may be constructed if there is an opportunity to do so without endangering the water supply of the school or the community. However, a septic tank with a sufficient amount of loose joint subsoil drains is the better method of sewage disposal when there is no sewer system to which the sewage of the school building is to be carried. Much care should be used in the construction of this tank in the composition of material, the arrangement of the compartments, size, and the disposal tile. The State Board of Health of Michigan will upon application offer suggestions for the construction of a septic tank.

ELECTRIC SERVICE

The electric service, installation, cabinets, fixtures, clocks, and telephones should be of the best material and workmanship. The electrical installation should be in accordance with the national electrical code of the National Board of Fire Underwriters for electric wiring and apparatus, or in accordance with the code prescribed by the ordinance of the city for the electrical work in private and public buildings. It is better that all wiring be in conduit.

The code issued by the Illuminating Engineering Society should serve as a guide in arranging the electric lights for lighting schoolrooms and school buildings.

SCHOOL SITES

LOCATION

A school district in selecting a site should keep in mind six principal factors:

(1) The orientation

(2) The topography

(3) The approaches to the building as they may affect the opportunity for beautifying the grounds

(4) The future growth and development of the school district

(5) The size

(6) The suitableness for play and physical educational activities

Low and swampy sites should not be selected because of unfavorable health conditions, and hillside sites should not be selected because there is no suitable place for children to play. Neither should sites be selected along railroad or street car tracks because of the noise and danger. Future growth of the district and the possible extention of railway lines should be considered when locating schools. It is well to locate the school near public parks and playgrounds so they may be utilized for play and recreation. Sites should not be selected near places that may have a demoralizing effect. There may be an element of danger if sites are located on highways that have much traffic. However, this danger is much reduced if the site is large enough so that the children are not likely to run into the road or street during their play. Often a school building can be located on the front part of the site and the playground at the back. Very often a desirable site can be selected off the main traveled highway but a school building should not be located where it cannot easily be seen by the people who support and maintain it.

The ideals of every person are influenced by trees, flowers, lawns, and beautiful buildings. The school ground is the people's investment. It should therefore be made an example for home improvement. It can be so developed that it will aid in the development of the artistic and the aesthetic. The grounds should be laid out with as much care as is followed in planning the school building.

There may be fences covered with vines and banked with shrubbery, or there may be hedges or shrub borders artistically arranged. Norway spruce, hemlock, mulberry, elder, dogwood, wild cherry, choke cherry, snowballs, honeysuckle, red cedar, sumac, winter berry, and mountain ash have their value for borders and landscape work. The spiraeas, meadow sweet, high bush cranberry, roses, hydrangeas, and rhododendrons are valuable for planting about the school building and yard.

use can be made of the Boston ivy, Virginia creeper, trumpet vine, and Dutchman's pipe where vines are desirable for covering places that mar the beauty of the landscape.

Beautiful grounds as well as beautiful architecture influence the development of character and ideals of children. Such influence teaches the children of the community to appreciate the beautiful things of life better than books and sermons can do it.

There is no good reason why a school building should stand out as a barren structure. By proper planting the outlines of the building can be softened and related to the surrounding landscape, the color scheme made to blend into the building, and the landscape to produce beauty and harmony of buildings and grounds. This effect can usually be secured by the proper placing of walks and drives and the planting of flowers and shrubbery. Curved walks and drives are useful and valuable in planning school grounds, for they conform more nearly to the natural trails and lend themselves well to the planting of trees, shrubs, and flowers. Nature does not plant her trees, flowers, and shrubs in straight and regular lines.

The plants selected should be selected according to the season in which the flowers and shrubbery are most beautiful, and the selection should be such that there is a continual beauty throughout the year. The plants should, therefore, be selected for their beauty, their adaptation to the climate, their artistic and pleasing appearance, their aesthetic value, and their harmonizing effect.

SIZE

A questionnaire was sent to the school districts which included incorporated villages and cities for the purpose of learning the size of the school sites for the various school districts of Michigan, and also for the purpose of ascertaining the extent to which school districts are furnishing play apparatus and play facilities for the pupils who are attending school. The answers to the questionnaire showed that only a small number of school districts connected with towns and cities have school sites of five acres or more, and that only a small number have the athletic field adjacent so that it may be used for general play purposes. The answers further showed that there is need that attention be given to providing places on school grounds for games, and that play apparatus should be supplied in sixty per cent of the schools.

Authorities vary somewhat as to the size of the site for the various kinds of schools. There is, however, good reason to require that the site for elementary school be two to five acres, the junior high school from five to ten acres, and the high school site from ten to fifteen acres or more. These sizes will vary somewhat according to the size of the school. The site should be of sufficient size to give ample opportunity

for free play for both boys and girls with separate playgrounds for each, as well as for the physical educational activities of the school. The grounds should be large enough to afford ample place for all those play activities which good teaching approves of. The recommendation of the National Education Association of 272 square feet of ground area per child will serve as a guide to the amount of land that should be selected for an elementary school site. The recommendation of the National Education Association of 270 square feet of ground area per child for junior high school sites will also serve as a guide in selecting junior high school sites. Junior and senior high school grounds may have a track and provision for basket ball, baseball, volley ball, hand ball, tennis courts for both boys and girls, as well as separate playgrounds for boys and girls. The elementary school grounds may have swings, teeters, slides, and other play apparatus which competent authorities deem necessary, that children may give healthful and suitable expression to their play instincts.

The playgrounds should not be rough and uneven. The surface may be covered with a sandy mixture that will wear well, but which will not injure a child if he should fall or be thrown upon it. The ground for ball fields and courts should be prepared in accordance with what practice has shown to be best. The Director of Physical Education of Michigan should be consulted before laying out the play field for free play and competitive sports. A list of apparatus and equipment may be secured by writing him at the Department of Public Instruction, Lansing.

USE

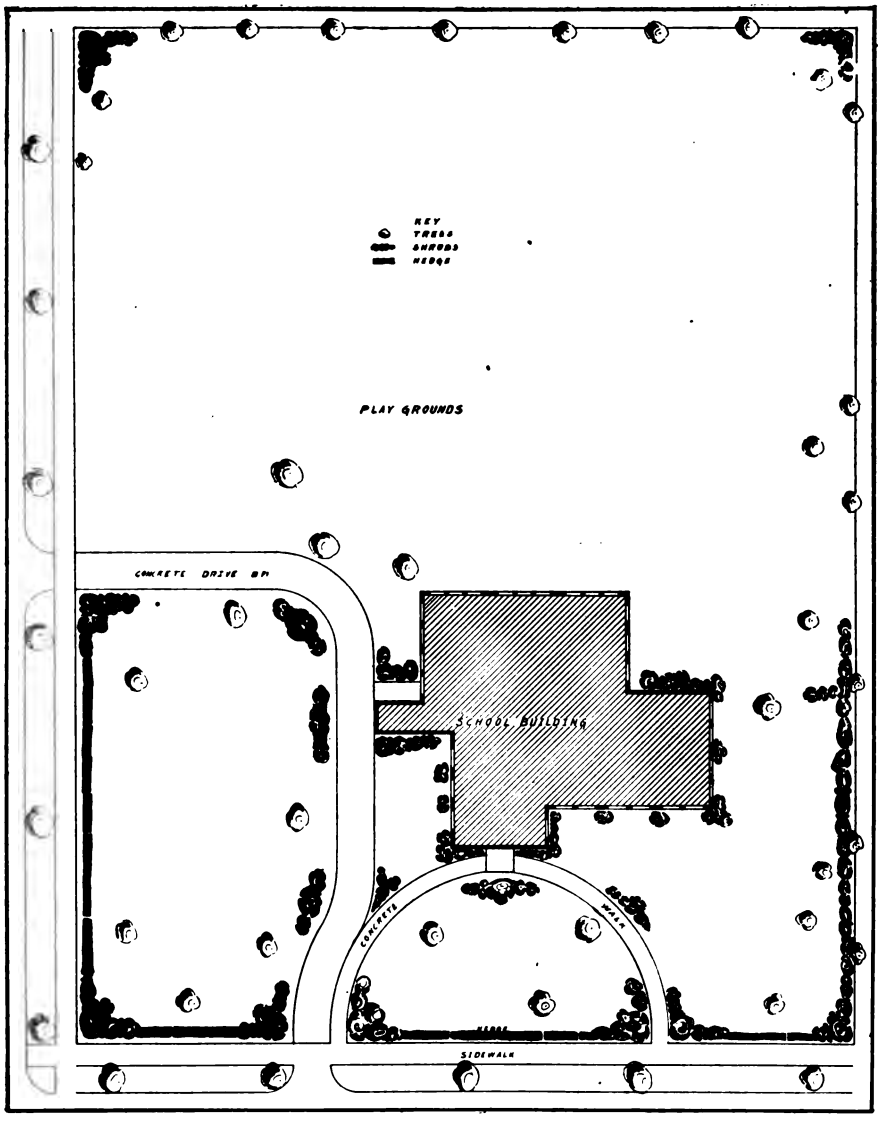
Every community may, through its playground, lay the foundation for good citizenship and sturdy manhood and womanhood. The playground offers an exceptional opportunity to train children in habits of self-control, courageous action, quick and accurate decisions, courtesy, respect for superiors, leadership, responsibility, co-operation, and the fundamental principles of government. The public is therefore vitally interested in this medium for the preparation of its children for individual and public service.

ILLUSTRATIONS

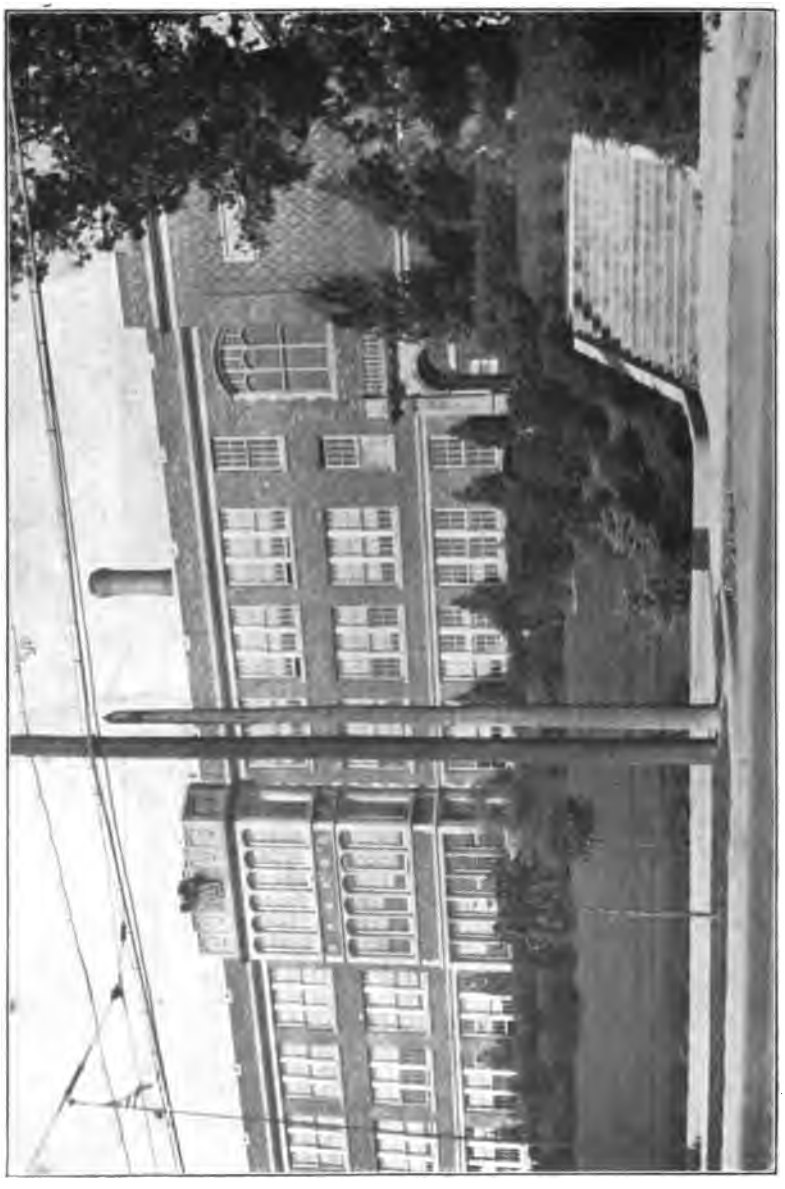
The following pictures of school yards and buildings with their plantings show what may be done by any school district to make the school property a beautiful place.

The five school site plats indicate how a school board may lay out its school grounds to give a place for buildings, a place for shrubs, flowers, trees, vines, and a place for the play activities. It is hoped that school officials will find these planting suggestions of service to them in improving their school property.

A diagram illustrating the planning and planting of a school site of less than one acre



A diagram illustrating the planning and planting of a school site of one acre



East Intermediate School, Jackson, Michigan. A treatment of a school site with high elevation and pronounced decline by the use of two grass terraces and careful landscape planting of shrubs, trees, evergreens, and hedges

A side view of a school site near the school building taken from the top of the hill showing the planting of carefully selected flowers, shrubs, dwarf trees, and evergreens to relieve the steepness of the hillside and to give beauty and character to the school building

Main entrance to the West Intermediate School, Jackson, three years from the time of planting

Pontiac High School, showing the careful arrangement of the plantings for the frontage of five acres

Pontiac High School, showing how plantings may be used for recesses in the wall. This arrangement illustrates the beautiful, well balanced planting of a colony of evergreens, vines on the building, shrubs, and weeping mulberry tree to soften the structural harshness of the brick wall

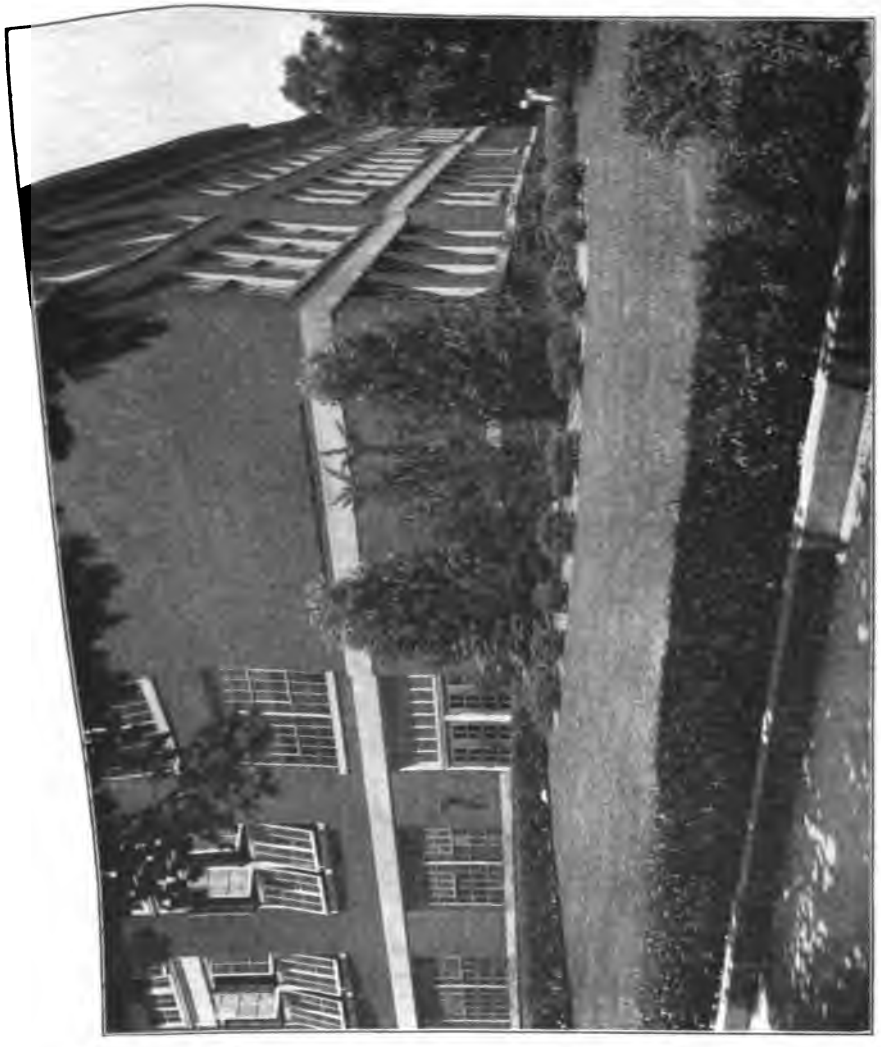
Pontiac High School, showing a beautiful landscape layout

The features of this school ground are the colonial, sentinel trees of evergreens, the flowering shrubs of selected varieties gracefully blending into the green open lawn

This picture illustrates the open lawn with its beautiful background of shrubbery and trees

An artistic treatment of a spacious school site

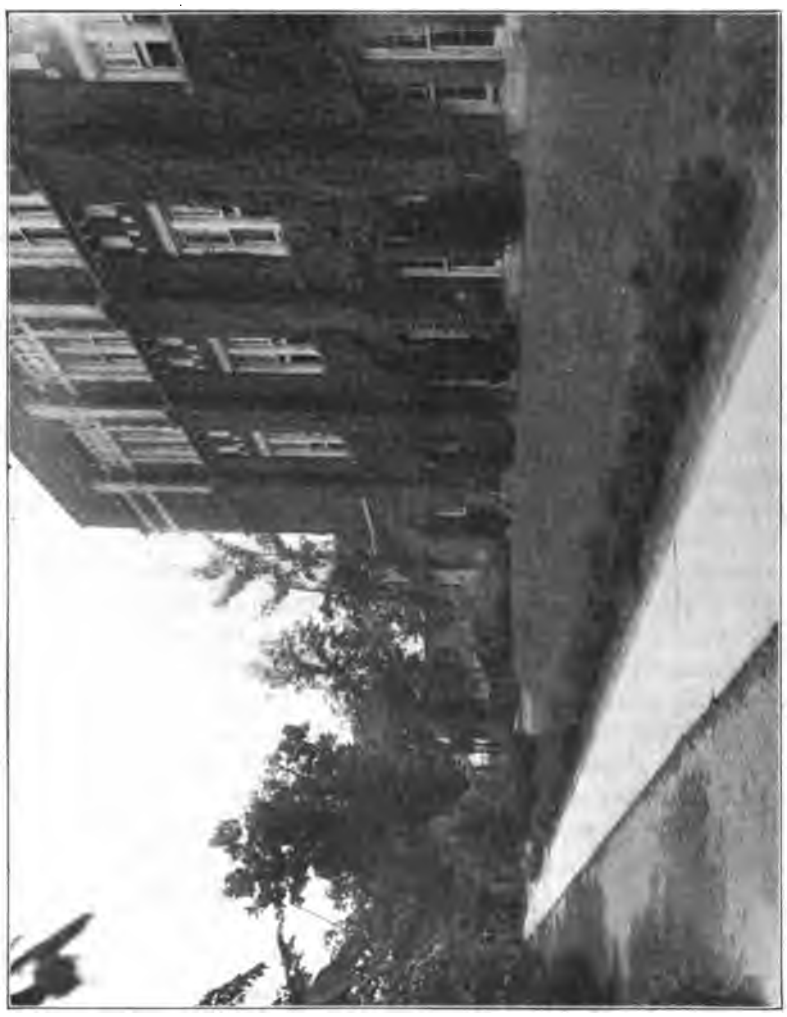
An artistic use of roses at the approach to a school building



This picture shows a corner of a school building beautifully treated by landscape planting to screen the bare brick walls

This picture illustrates a blending of formal and informal landscape planting

This view illustrates an example of the arrangement of plantings along the approach to the school building



This picture illustrates the treatment of a narrow space between the sidewalk and the foundation wall of the school building

CONCLUSION

The broad fundamental principles relating to school construction will be similar in the various school districts of the state. School authorities and architects should have no difficulty in working out the construction to meet the special needs of any school district. We trust this building bulletin will be of service to both school authorities and architects in the school building construction of this state.

THE MICHIGAN SCHOOL BUILDING LAW

ACT NO. 17 OF THE PUBLIC ACTS OF 1915, AS AMENDED BY ACT NO. 137 OF THE PUBLIC ACTS OF 1919.

Section 1. No schoolhouse shall hereafter be erected in any school district in this State, and no addition to a school building in any such district shall hereafter be erected, the cost of either of which shall exceed three hundred dollars, until the plans and specifications for the same shall have been submitted to the Superintendent of Public Instruction and his approval indorsed thereon. Such plans and specifications shall be submitted in duplicate and shall show in detail the ventilation, heating and lighting: Provided, That the said Superintendent of Public Instruction shall have authority to inspect such building or buildings during the process of construction in order to determine that the provisions of this act are being complied with.

Section 2. The Superintendent of Public Instruction shall have authority to inspect and condemn schoolhouses. After an inspection of a schoolhouse, if in the judgment of the said Superintendent of Public Instruction such building, or any part thereof, is not in a safe and sanitary condition, notice thereof shall be given to the district board or board of education of the district in which such building is located, said notice to be given at least six months preceding the first day of August. On the first day of August following such notice given, if said building has not been placed in a safe and sanitary condition by the district board or board of education, said Superintendent of Public Instruction shall have authority to close such building or part thereof, and such building, or part thereof, shall not again be opened for public use until such building, or part thereof, shall have been placed in safe and sanitary condition to the satisfaction of the said Superintendent of Public Instruction; Provided, That after such building, or part thereof, has been closed for public use said Superintendent of Public Instruction shall be authorized and he is hereby required to have such building, or part thereof, placed in a safe and sanitary condition at the expense of the district: Provided, That any district board or board of education, being dissatisfied with the order of the Superintendent of Public Instruction determining such schoolhouse to be in an unsafe or insanitary condition, may within thirty days of the issuance of such order and notice thereof, commence an action in the circuit court in chancery for the county in which such schoolhouse is located, against the Superintendent of Public Instruction as defendant, to vacate and set aside such order on the ground that said order is unlawful or unreasonable; in which suit the Superintendent

of Public Instruction shall be served with subpoena and a copy of the complaint.

Section 3. No tax voted by a district meeting, or other competent authority in any such school district, exceeding the sum of three hundred dollars for building purposes, shall be expended by the district board or board of education of such district until the Superintendent of Public Instruction shall certify that the plans and specifications for the same comply with the provisions of this act.

Section 4. No heating system shall hereafter be installed in any schoolhouse in this State, nor shall any heating system be replaced by another heating system in any schoolhouse of this State, until the plans and specifications for the same shall have been submitted to the Superintendent of Public Instruction and his approval indorsed thereon. The plans and specifications shall make provision for ventilation either as a part of or in connection with the heating system and shall be submitted in duplicate to the Superintendent of Public Instruction.

Section 5. It shall be unlawful for any officer, board, committee, architect, builder, civil engineer, plumber, carpenter, mason, contractor, subcontractor, foreman, or employe to vary from plans and specifications approved by the Superintendent of Public Instruction without his written consent, or otherwise violate, or assist in violating any of the provisions contained in this act. Any person, board, firm, or corporation who violates any of the provisions of this act shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine not to exceed one hundred dollars or imprisonment in the county jail for a period of not to exceed thirty days, either or both in the discretion of the court.

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